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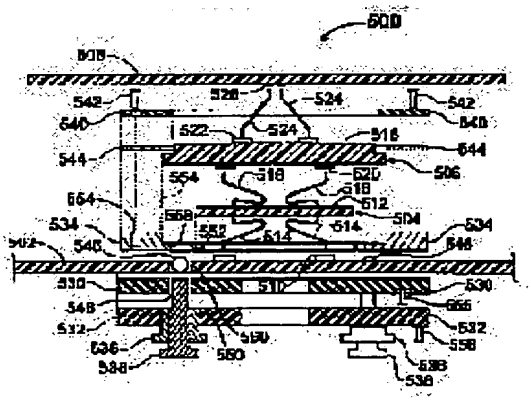
(54) PROBE CARD ASSEMBLY AND KIT, AND METHOD FOR USING THEM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a device to come into press-contact with an electronic component by providing an interval converter board having multiple first terminals arranged on the upper surface and multiple second terminals arranged on the lower surface, and multiple restorable contact structures which are directly mounted to the multiple first terminals.
SOLUTION: This probe card assembly 500 comprises a probe card 502, an interleaved body 504 and an interval converter 506, and is tentatively connected with a semiconductor wafer 508. The probe card 502 is a conventional circuit board having multiple contact regions 510 arranged on its upper surface, and an electronic component, a connector or the like can be mounted to the probe card 502 as well. The interleaved body 504 includes a board 512. Multiple restorable mutual connection elements 514 are mounted on the lower surface of the board 512 and extended downward from there, and multiple corresponding restorable mutual connection elements 516 are mounted on the upper surface of the board 512 and extended upward from there.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] the spacing converter substrate which has two or more 1st terminals arranged in an up front face, a lower front face, and this up front face, and two or more 2nd terminals arranged in the above-mentioned lower front face in the spacing converter for probe card assemblies, and contact structure with two or more 1st stability directly mounted in two or more terminals of the above 1st -- since -- the becoming spacing converter.
[Claim 2] The spacing converter according to claim 1 which consists of tip structure mounted in the edge of contact structure with said two or more 1st stability further.
[Claim 3] The contact structure with said two or more 1st stability is a spacing converter according to claim 1 which is a compound interconnect element.
[Claim 4] The contact structure with said two or more 1st stability is a spacing converter according to claim 1 manufactured on a sacrifice substrate before mounting contact structure with said two or more 1st stability in said two or more 1st terminals directly.
[Claim 5] The spacing converter according to claim 1 which consists of contact structure with two or more 2nd stability directly mounted in said two or more 2nd terminals further.
[Claim 6] The contact structure with said two or more 2nd stability is a spacing converter according to claim 1 which is a compound interconnect element.
[Claim 7] The contact structure with said two or more 2nd stability is a spacing converter according to claim 1 manufactured on a sacrifice substrate before mounting contact structure with said two or more 2nd stability in said two or more 2nd terminals directly.
[Claim 8] The probe card which has two or more contact terminals which are probe cards and can be set in a probe card assembly on an up front face, a lower front face, and this up front face, The mediation object which has the contact structure which is a mediation object and has two or more 1st stability extended from an up front face, a lower front face, and the lower front face of a mediation object, and contact structure with two or more 2nd stability extended from the up front face of a mediation object, Two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter, and the spacing converter which has contact structure with two or more 3rd stability extended from the up front face of a spacing converter, the contact structure with two or more stability of the above 1st bringing about the pressure connection with the contact terminal of the above-mentioned probe card and the contact structure with two or more stability of the above 2nd bring about the pressure connection with the contact pad of the above-mentioned spacing transducer -- since -- the becoming probe card assembly.
[Claim 9] The contact structure with said two or more 3rd stability is a probe card assembly according to claim 8 directly mounted in the terminal in the up front face of said spacing transducer.
[Claim 10] The contact structure with said two or more 1st stability is a probe card assembly according to claim 8 which is a compound interconnect element.
[Claim 11] The contact structure with said two or more 2nd stability is a probe card assembly according to claim 8 which is a compound interconnect element.
[Claim 12] The contact structure with said two or more 3rd stability is a probe card assembly

according to claim 8 which is a compound interconnect element.
[Claim 13] Each of contact structure with said two or more 1st stability is a probe card assembly according to claim 8 which are at least two compound interconnect elements.
[Claim 14] Each of contact structure with said two or more 2nd stability is a probe card assembly according to claim 8 which are at least two compound interconnect elements.
[Claim 15] the anterior part mounting plate with which it is manufactured from a strong ingredient, it has an up front face and a lower front face, and this lower front face is arranged against said up front face of said probe card, the means for fixing the above-mentioned anterior part mounting plate to said up front face of said probe card, and the means for pressing said spacing transducer against said up front face of said probe card -- since -- the probe card assembly according to claim 8 which becomes further.
[Claim 16] Said anterior part mounting plate is a probe card assembly according to claim 15 manufactured from stainless steel.
[Claim 17] two or more screws with which said means for pressing said spacing converter holds a mounting ring and this mounting ring to said anterior part mounting plate with said spacing converter caught among them -- since -- the becoming probe card assembly according to claim 15.
[Claim 18] Said mounting ring is a probe card assembly according to claim 17 manufactured from an elastic ingredient.
[Claim 19] The probe card assembly according to claim 17 which consists of said mounting ring and a spacer ring arranged between said spacing transducers further.
[Claim 20] the regions-of-back mounting plate with which said means for fixing said anterior part mounting plate has an up front face and a lower front face, and this up front face is arranged against said lower front face of said probe card, and two or more screws extended through said probe card between said anterior part mounting plate and the above-mentioned regions-of-back mounting plate -- since -- the becoming probe card assembly according to claim 15.
[Claim 21] Said regions-of-back mounting plate is a probe card assembly according to claim 20 manufactured from stainless steel.
[Claim 22] The probe card assembly according to claim 8 which consists of a means for adjusting the smoothness of said spacing transducer further, without changing the orientation of said probe card.
[Claim 23] It is the probe card assembly according to claim 22 which contains the external differential screw element and the internal differential screw element with which the each acts on the lower front face of said spacing transducer by said means for adjusting the smoothness of said spacing transducer consisting of two or more differential screws.
[Claim 24] The probe card assembly according to claim 23 which consists of two or more pivot balls arranged in the edge of the differential screw element of said interior further.
[Claim 25] It is the probe card assembly according to claim 23 with which it consists of an actuator mounting plate arranged immediately in the bottom of said probe card further, and screw through [of said differential screw] is carried out into this actuator mounting plate.
[Claim 26] Said means for adjusting the smoothness of said spacing converter is a probe card assembly according to claim 22 which consists of two or more actuators which answer a computer and act on the lower front face of said spacing converter.
[Claim 27] It is the 2nd pitch, and is arranged in the up front face of said spacing transducer, and, for the 1st pitch of the above, the contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing transducer, and has said two or more 3rd stability is a larger probe card assembly according to claim 8 than the 2nd pitch of the above.
[Claim 28] It is the 2nd pitch, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which the contact structure with said two or more 1st stability is the 1st pitch, is arranged in the lower front face of said mediation object, and has said two or more 2nd stability is the same probe card assembly according to claim 8 as the 2nd pitch of the above.
[Claim 29] The contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing converter, and has said two or more 3rd stability The contact

structure which is arranged in the up front face of said spacing converter, and has said two or more 1st stability in the 2nd pitch It is the 1st pitch of the above, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which is arranged in the lower front face of said mediation object, and has said two or more 2nd stability in the 1st pitch of the above is a larger probe card assembly according to claim 8 than the 2nd pitch of the above.

[Claim 30] It has contact structure with two or more 1st stability extended from two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter in a probe card kit, and the up front face of a spacing converter. The spacing converter which was adapted for using to two or more surfaces of action on a semiconductor wafer, and the tip of contact structure with two or more stability of the above 1st which makes pressure contact, Are a mediation object and it has contact structure with two or more 2nd stability extended from an up front face, a lower front face, and the up front face of a mediation object. Make two or more above-mentioned contact pads and pressure connection in the lower front face of the above-mentioned spacing converter. It is adapted for using to the tip of contact structure with two or more stability of the above 2nd, and has contact structure with two or more 3rd stability extended from the lower front face of a mediation object. the mediation object which was adapted for using to two or more terminals on a probe card, and the tip of contact structure with two or more 3rd stability which makes pressure connection -- since -- the becoming probe card kit.

[Claim 31] It is the 2nd pitch, and is arranged in the up front face of said spacing transducer, and, for the 1st pitch of the above, the contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing transducer, and has said two or more 1st stability is a larger probe card kit according to claim 30 than the 2nd pitch of the above.

[Claim 32] It is the 2nd pitch, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which the contact structure with said two or more 3rd stability is the 1st pitch, is arranged in the lower front face of said mediation object, and has said two or more 2nd stability is the same probe card kit according to claim 30 as the 2nd pitch of the above.

[Claim 33] The contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing converter, and has said two or more 1st stability The contact structure which is arranged in the up front face of said spacing converter, and has said two or more 3rd stability in the 2nd pitch It is the 1st pitch, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which is arranged in the lower front face of said mediation object, and has said two or more 2nd stability in the 1st pitch is a larger probe card kit according to claim 30 than the 2nd pitch of the above.

[Claim 34] the tip structure of the preliminary manufacture connected with the above-mentioned edge of the compound interconnect element which has an edge, and this compound interconnect element in contact structure with stability -- since -- contact structure with the becoming stability.

[Claim 35] The contact structure with said stability is contact structure with stability according to claim 34 which is the probe element mounted in a spacing transducer.

[Claim 36] The step which deposits at least one layer of at least one electrical conducting material on a silicon wafer in the approach of manufacturing tip structure to the edge of contact structure, the above -- with the step which deposits the layer of a masking material on the crowning of one conductive layer even if few The approach containing the step which carries out patterning of the opening in the above-mentioned masking material, the step which deposits at least one layer of at least one electrical conducting material in the above-mentioned opening, and the step which removes the above-mentioned masking material.

[Claim 37] The approach according to claim 36 of containing further the step which deposits a connection ingredient on said at least one layer of at least one electrical conducting material deposited in said opening before.

[Claim 38] The approach according to claim 37 of containing further the step which connects said tip structure with the edge of said contact structure.

[Claim 39] Said contact structure is the approach according to claim 38 of being contact structure with stability.
[Claim 40] Said contact structure is the approach according to claim 38 of being a compound interconnect element.
[Claim 41] Said contact structure is the approach according to claim 38 of being the contact structure with stability arranged by the crowning of the spacing converter of a probe card assembly.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is further preceded with mounting of a semiconductor device about making temporary pressure connection between electronic components at a detail, and suitably, before each semiconductor device is simplified from a semiconductor wafer, it relates to the technique for carrying out the trial and aging procedure about a semiconductor device.
[0002]
[Description of the Prior Art] This application is the United States patent (situation: pending in court) copending application 08th for which it applied on May 26, 1995 by the same applicant / No. 452,255 (henceforth). It is continuation application a part. it is called a "parent example" -- this United States patent application The United States patent (situation: pending in court) copending application 08th / No. 340,144 for which it applied on November 15, 1994 by the same applicant, And the correspondence PCT patent application number PCT/US 94/13373 (it announces publicly as WO 95/14314 on May 26, 1995) for which it applied on November 16, 1994 is continuation application a part. the United States patent (situation: pending-in-court/license) copending application 08th for which it applied on November 16, 1993 according [they] to the same application in both / No. 152,812 -- it is continuation application a part.
[0003] the United States patent (situation: pending in court) copending application 08th for which it applied on September 21, 1995 according [this application] to the same applicant again / No. 526,246, and the United States patent (situation: pending in court) copending application 08th which applied on October 18, 1995 by the same applicant / No. 533,584 -- it is also continuation application a part.
[0004] Each semi-conductor (integrated circuit) component (die) is usually manufactured by making some same components on a semiconductor wafer using a known technique of phot lithography, deposition, and others. Before these processes simplify each die from a semiconductor wafer (cutting), they aim general at making two or more integrated circuit devices which function completely. However, it is not avoided in fact that the defect of a certain kind at the time of processing the physical defect of a certain kind in the wafer itself and a wafer of some of the dies is "good" (it functions completely), and some of the dies become the cause of being "wrong" (it not functioning). Generally it is desirable that it is discriminable before they are suitably simplified [which is good among two or more dies on a wafer and] from a wafer before those mounting. For this purpose, a wafer "a testing device" or "probe equipment" is used advantageously, and two or more discrete pressure connection is made to two or more discrete connection pads (adhesion pad) similarly on a die. Thus, it becomes possible to examine and operate a semi-conductor die, before simplifying a die from a wafer. The idiomatic component of a wafer testing device is a "probe card", two or more probe elements are connected to this, and the tip of a probe element brings about pressure connection to the adhesion pad with which a semi-conductor die corresponds.
[0005] It is the kimono which a certain kind of difficulty has in a semi-conductor die at which technique which applies a probe. For example, the latest integrated circuit contains the adhesion

pad of the thousands arranged by approaching mutually (5 mils of for example, centers to center). Furthermore, the layout of an adhesion pad does not need to be limited to the single train of the adhesion pad arranged near the circumference edge of a die (see U.S. Pat. No. 5,453,583).

[0006] In order to bring about the pressure connection with sufficient dependability between a probe element and a semi-conductor die, it is necessary to make an issue of some parameters, and although it is not limitation, alignment, the probe force, an overdrive, contact force, the balanced contact force, washing, contact resistance, and flattening are contained in these. Although the general argument of these parameters can be found out to U.S. Pat. No. 4,837,622 entitled "a high density probe card (HIGH DENSITY PROBE CARD)" and being incorporated on these specifications by considering this as reference, the high density epoxy ring probe card containing the unit type printed circuit board equipped with central opening which suited this patent so that the epoxy ring by which the probe element was preformed might be received is indicated.

[0007] Generally, two or more tungsten needles extended as a cantilever from one front face of a probe card are contained in the probe card assembly of the conventional technique. A tungsten needle is mounted in a probe card by agency of the above epoxy rings etc. by the suitable method of arbitration. Generally, in any case, a needle is wired by agency of the separate and unique wire which connects a needle to the terminal of a probe card at the terminal of a probe card.

[0008] A probe card is usually formed as a circular ring, and these are equipped with the probe element (needle) of hundreds (and the terminal of a probe card wires) extended from the inner circumference of a ring. a circuit module -- and equal electric conduction trace (line) of die length is suitably related with each of a probe element. According to this ring configuration layout, when the adhesion pad of each semi-conductor die is especially arranged except two straight-line arrays which met two opposite edges of a semi-conductor die, it becomes difficult to apply a probe to two or more semi-conductor dies (a large number site) with which it is not simplified on the wafer, and, in a certain case, it becomes impossible.

[0009] The probe film which has a central contact bump field can also be used for a wafer testing device as an alternative, and this is indicated by U.S. Pat. No. 5,422,574 entitled "the large-scale protrusion film for the semiconductor devices under the trial equipped with the number of super-** pins (LARGE SCALE PROTRUSION MEMBRANE FOR SEMICONDUCTOR DEVICES UNDER TEST WITH VERY HIGH PIN COUNTS)", and is incorporated on these specifications by considering this as reference. "A trial system consists of a probe card for usually maintaining exact mechanical contact for the trial controller for performing and controlling a series of test programs, the wafer distribution system for dealing with a wafer mechanically and positioning it as pretest preparation, and an examined component (DUT)" (the 1st paragraph, 41 to 46 lines) is indicated by this patent.

[0010] Although further bibliography is considered as reference and incorporated on these specifications, to these The technical condition in the trial of a semiconductor device is expressed. U.S. Pat. No. 5,442,282 "TESTING ANDEXERCISING INDIVIDUAL UNSINGULETED DIES ON A WAFER", said -- the 5,382,898th a number ("HIGH DENSITY PROBE CARD FOR TESTING ELECTRICAL CIRCUITS") -- said -- the 5,378,982nd a number ("TEST PROBE FOR PANEL HAVING AN OVERLYING PROTECTIVE MEMBERADJACENT CONTACTS") -- said -- the 5,339,027th a number ("RIGID-FLEX CIRCUITS WITH RAISED FEATURES AS IC TEST PROBE") -- said -- the 5,180,977th a number ("MEMBRANE PROBE CONTACT BUMP COMPLIANCY SYSTEM") -- said -- the 4,757,256th a number ("HIGH DENSITY PROBE CARD") -- said -- the 4,161,692nd a number ("PROBE DEVICE FOR INTEGRATED CIRCUIT WAFERS") -- and -- said -- the 3,990,689th A number ("ADJUSTABLE HOLDER ASSEMBLY FOR POSITIONING A VACUM CHUCK") is contained.

[0011] Generally, the interconnect between electronic components can be classified into the category of two wide senses called permanent ["relatively permanent"] and "immediately dismountable" interconnect.

[0012] There is a soldered joint as an example of "relatively permanent" connection. Once two

components of each other are soldered, although these components are separated, it is necessary to use a solder removal process. Wire adhesion is other examples of "relatively permanent" connection.

[0013] As an example of "immediately dismountable" connection, there is a pin with one strong electronic component, and it is received with the elastic socket element of other electronic components. A socket element does the contact force (pressure) of sufficient magnitude to guarantee electrical connection with reliance between them to a pin.

[0014] The interconnect element aiming at making an electronic component and pressure contact is called a "spring" or a "spring element" in this specification. Generally, bringing the pressure contact with sufficient (for for example, terminal on an electronic component) dependability to an electronic component is expected some minimum contact force. for example, guaranteeing making electrical connection with dependability sufficient for the terminal of the electronic component which is polluted with the film on a front face, and has corrosion or an oxidation product on a front face is expected about 15g (per contact -- being few -- 2g or less -- and and 150g or more is included) contact (load) force. To increase either the yield strength of a spring ingredient or the dimension of a spring element is needed for the minimum contact force required for each spring. As a general proposal, it becomes still more difficult to process it (for example, piercing bending etc.), so that the yield strength of an ingredient becomes high. And it essentially becomes impossible to manufacture those cross sections still more greatly by possibility of saying that he wants to manufacture a spring still smaller.

[0015] Especially a probe element is one classification of the spring element relevant to this invention. The probe element of the conventional technique is manufactured from a general comparatively hard tungsten (high yield strength). When it is a request to mount this comparatively hard ingredient in the terminal of an electronic component, processes comparatively "severe" (for example, elevated temperature), such as a brazing-and-soldering method, are needed. Generally this "severe" process is not desirable in relation to some electronic components comparatively "brittle", such as a semiconductor device, (it is unrealizable again in many cases). In contrast with it, it is an example of a process with wirebonding comparatively "easy", and this does not almost have doing damage to a brittle electronic component by the case than a brazing-and-soldering method. Soldering is other examples of a process comparatively "easy." However, solder and gold are both comparatively elasticity ingredients (low yield strength), and these do not fully function as a spring element.

[0016] Other delicate problems relevant to an interconnect element including spring contact are often in the point which does not have the terminal of an electronic component ******** completely. In order to absorb such "tolerance" (total coplanarity), the interconnect element which lacks in a certain device both incorporated will be pressed violently, and will make the pressure contact to which the terminal of an electronic component cohered.

[0017] Although incorporated on these specifications by considering the following United States patents as reference, these are mentioned to an electronic component considering making field opposite connection, especially pressure connection as a general problem. These United States patents U.S. Pat. No. 5,386,344 "FLEX CIRCUIT CARD ELASTOMERIC CABLE CONNECTOR ASSEMBLY", said -- the 5,336,380th a number ("SPRINGBIASED TAPERED CONTACT ELEMENTS FOR ELECTRICAL CONNECTORS AND INTEGRATED CIRCUIT PACKAGES") -- said -- the 5,317,479th a number ("PLATED COMPLIANT LEAD") -- said -- the 5,086,337th a number ("CONNECTING STRUCTURE OF ELECTRONIC PART AND ELECTRONIC DEVICE USING THE STRUCTURE") -- said -- the 5,067,007th a number ("SEMICONDUCTOR DEVICE HAVING LEADS FOR MOUNTING TO A SURFACE OF A PRINTED CIRCUIT BOARD") -- said -- the 4,989,069th a number ("SEMICONDUCTOR PACKAGE HAVING LEADS THAT BREAK-AWAYFROM SUPPORTS") -- said -- the 4,893,172nd a number ("CONNECTING STRUCTUREFOR ELECTRONIC PART AND METHOD OF MANUFACTURING THE SAME") -- said -- the 4,793,814th a number ("ELECTRICAL CIRCUIT BOARD INTERCONNECT") -- said -- the 4,777,564th a number ("LEADFRAME FOR USE WITH SURFACE MOUNTED COMPONENTS") -- said -- the 4,764,848th a number ("SURFACE MOUNTED ARRAY STRAIN RELIEF DEVICE") -- said -- the 4,667,219th a number ("SEMICONDUCTOR CHIP

INTERFACE") -- said -- the 4,642,889th a number ("COMPLIANT INTERCONNECTIONAND METHOD THEREFOR") -- said -- the 4,330,165th a number ("PRESS-CONTACT TYPE INTERCONNECTORS") -- said -- the 4,295,700th a number ("INTERCONNECTORS") -- This 4,067,104th number () ["MEHOD] OF FABRICATING AN ARRAY OF FLEXIBLE METALLIC INTERCONNECTS FORCOUPLING MICROELECTRONICS COMPONENTS", said -- the 3,795,037th a number ("ELECTRICAL CONNECTOR DEVICE") -- said -- the 3,616,532nd a number ("MULTILAYER PRINTED CIRCUITELECTRICAL INTERCONNECTION DEVICE") -- and -- said -- the 3,509,270th It is a number ("INTERCONNECTION FOR PRINTED CIRCUITS AND METHOD OF MAKING SAME").

[0018]

[Problem(s) to be Solved by the Invention] Especially one purpose of this invention is offering the technique for carrying out probe inspection of the semiconductor device, while their are on a semiconductor wafer.

[0019] Other purposes of this invention are offering the technique for applying a probe to a semiconductor device made possible, without changing the location of a probe card for the orientation at the tip of a probe element.

[0020] Other purposes of this invention are offering the improved spring element (contact structure with stability) which can be directly mounted in the terminal of an electronic component.

[0021] Other purposes of this invention are offering the interconnect element suitable for making pressure contact to an electronic component.

[0022]

[Means for Solving the Problem] According to this invention, for a probe card assembly The probe card which has an up front face, a lower front face, and two or more terminals that can be set on the up front face (electronic component), Contact structure with two or more 1st stability extended from an up front face, a lower front face, and the terminal in the lower front face, And the mediation object which is extended from the terminal in the up front face and which has contact structure with two or more 2nd stability (electronic component), The spacing converter which is extended from an up front face, a lower front face, two or more contact pads (terminal) arranged in the lower front face, and the terminal in the up front face and which has contact structure (probe element) with the 3rd stability is contained.

[0023] A mediation object makes it possible to be arranged between the up front face of a probe card, and the lower front face of a spacing transducer, and to adjust the orientation (surface smoothness) of a spacing transducer, without changing the orientation of a probe card. The technique for determining the device suitable for bringing about adjustment of the orientation of this spacing converter and the orientation where a spacing converter is exact is indicated by this specification. Thus, the tip (distal end) of a probe element is adjusted and it becomes possible to guarantee the pressure contact with sufficient dependability between the tip of a probe element, and the adhesion pad (terminal) with which the semiconductor device by which probe inspection is carried out corresponds.

[0024] The contact structure which has two or more stability as an alternative is prepared in the lower front face of a spacing converter component (that is, manufactured on the terminal on the front face of lower of a spacing converter) in order to contact the terminal on the front face of up of a probe card directly (namely, there is no agency of a mediation object) instead of a mediation object component.

[0025] Generally, with a spacing converter component, contact structure with two or more stability extended from the up front face becomes possible [connecting with the spacing converter (namely, contact structure which has stability as an adhesion pad or an alternative) in the lower front face in a comparatively coarse pitch] at the same time it contacts the terminal (namely, adhesion pad of a semiconductor device) of an electronic component in a comparatively detailed pitch (spacing).

[0026] According to one mode of this invention, the spacing transducer and mediation object component of a probe card assembly are prepared as a "kit" which suited using it with a probe card. It is also possible to include the device for adjusting the orientation of a spacing converter

in a kit as arbitration.
[0027] According to one mode of this invention, the contact structure (probe element) with the stability extended from the up front face of a spacing transducer component is a "compound interconnect element" (specified below). In an alternative of contact structure with the stability extended from the lower front face of a spacing converter, these can be similarly made into a "compound interconnect element."
[0028] According to one mode of this invention, the contact structure with stability extended from the up front face and lower front face of a mediation object component is a "compound interconnect element" (specified below).
[0029] According to one mode of this invention, a probe element (contact structure with stability extended from the up front face of a spacing transducer component) is suitably formed as a "compound interconnect element" manufactured directly on the terminal of the spacing transducer component of a probe card assembly. In order that a "compound" (multilayer) interconnect element may mount an expanding element ("core") in an electronic component, it may fabricate so that it may have a spring configuration, it may strengthen the physical (for example, spring) property of the compound interconnect element as a result and/or may conclude the compound interconnect element as a result certainly in an electronic component, it is manufactured by performing protective coat generation to a core. The contact structure with the stability of a mediation object component can also be formed as a compound interconnect element again.
[0030] Use of the vocabulary "compound" should not be confuse with any use of the vocabulary "compound" in other fields of an attempt which be perform to ingredients, such as other fiber which be in agreement with terminological (for example, form from two or more elements) 'generic' semantics, for example, be support by the base material of glass, carbon or resin, and others, through the explanation indicated on these specifications.
[0031] The vocabulary the "spring configuration" used on these specifications says the configuration of the de facto arbitration of an expanding element of showing elastic (restoration) movement of the edge (tip) of an expanding element, to the force applied at a tip. A straight expanding element is also substantially contained in this in addition to the expanding element fabricated so that it might have one or more bends.
[0032] The "surface of action", the "terminal" and the "pad" which are used on these specifications, and the similar vocabulary say the electric conduction field of the arbitration on the electronic component of arbitration with which an interconnect element makes mounting or contact.
[0033] As an alternative, a core is cast, before mounting in an electronic component.
[0034] or [that a core is mounted as an alternative in some sacrifice substrates which are not electronic components] — or they are some sacrifice substrates. A sacrifice substrate is removed in after shaping and protective coat generation before, or one of the back. According to one mode of this invention, the tip which has various kinds of structural descriptions can be arranged in the contact edge of an interconnect element. (Please refer to drawing 11 A-11F of the parent example mentioned above.) In the case of one example of this invention, a core is "elasticity" ingredient which has comparatively low yield strength, and protective coat generation is carried out with the "hard" ingredient which has comparatively high yield strength. For example, elasticity ingredients, such as a golden wire, are attached in the adhesion pad of a semiconductor device (for example, wirebonding), and protective coat generation is carried out with hard material, such as nickel and its alloy, (for example, electrochemistry plating).
[0035] The protective coat extended to some of overall lengths of the field opposite protective coat of a core, a single and a multilayer protective coat, the "coarse" protective coat (also refer to drawing 5 C and 5D of a parent example) that has a detailed lobe, and a core, or core length is indicated. In the case of the latter, the tip of a core is appropriately exposed, in order to make an electronic component contact (please also refer to drawing 5 B of a parent example).
[0036] Generally, the vocabulary "plating" is used for a core as an example of much techniques for generating a protective coat through the explanation indicated on these specifications. The various processes accompanied by deposition of the ingredient from a water solution although

limitation is not within the limits of this invention, By the suitable technique of electrolytic plating, electroless deposition, a chemical-vapor-deposition method (CVD), physical vapor growth (PVD), the process that lets the induction disintegration of a liquid or the quality of the solid-state antecedent pass, and produces and cheats out of deposition of an ingredient, and the arbitration containing others Generally all these techniques for being able to carry out protective coat generation and depositing an ingredient on a core are the places of common knowledge.
[0037] Generally, in order to carry out protective coat generation with metallicity ingredients, such as nickel, an electrochemical process is suitable and especially electroless deposition is desirable.
[0038] In the case of other examples of this invention, a core is the expanding element of the "hard" ingredient which was essentially suitable for functioning as a spring element, and is mounted in the terminal of an electronic component in an end. Protective coat generation of the adjoining field is carried out at least with the ingredient of a core and a terminal which strengthens the conclusion to the terminal of a core. Thus, in advance of protective coat generation, a core does not necessarily need to be enough mounted in a terminal, uses the process which hardly does damage to an electronic component potentially, and the "temporary stop" of the core is carried out to a proper place to consecutive protective coat generation. Soldering of the edge of the hard core to the elasticity part of a terminal, attachment, and thrust **** are contained in a process [these / "it is easy"].
[0039] Suitably, a core takes the gestalt of a wire. As an alternative, a core is a flat tab (conductive metal ribbon).
[0040] A typical ingredient is indicated by both a core and the protective coat.
[0041] Henceforth, the technique accompanied by mainly starting with the comparatively elastic core (low yield strength) which is a general very small dimension (for example, 3.0 mils or less) is explained. Elasticity ingredients, such as gold which adheres to a semiconductor device easily, do not have stability sufficient generally to function as a spring. (This elastic metallicity ingredient shows the Lord instead of elastic deformation plasticity deformation.) Other elasticity ingredients which adhere to a semiconductor device easily and have suitable stability are non-conductive in many cases, and, in the case of most spring materials, this is so. In any case, structural [desired] and the desired protective coat to which electrical characteristics are given over a core can give the compound interconnect element as a result. The compound interconnect element as a result can be manufactured very small, and can also present still more suitable contact force. Furthermore, the compound interconnect element which plurality requires can be arranged in a detailed pitch (for example, 10 mils), though they have quite bigger die length (for example, 100 mils) than the distance (the distance between adjoining interconnect elements is called a "pitch") over an adjoining compound interconnect element.
[0042] A compound interconnect element can sometimes be manufactured within the limits of this invention on a micro scale like the "micro spring" for a connector and sockets which has the cross-section dimension of extent for example, below 25 microns (micrometer). This capacity that the good interconnect of dependability which has the dimension measured not by the mill but by the micron can be manufactured copes with a developing demand which is called an existing interconnect technique and a future area array technique head-on.
[0043] The compound interconnect element of this invention presents outstanding electrical characteristics, and conductivity, soldering possibility, and low contact resistance are contained in this. the deviation of the interconnect element which answered the contact force applied in many cases — as a result — "— it is useful to guaranteeing that wipe, become" contact and this makes good contact of dependability.
[0044] The interconnect element of this invention and the connection made have the advantage of an addition of this invention in a dismountable point easily. Although soldering which brings interconnect to the terminal of an electronic component is arbitrary, generally it is not desirable in a system level.
[0045] According to one mode of this invention, the approach for manufacturing the interconnect element which has the impedance controlled is indicated. Generally, in such techniques, an electric conduction core or the whole compound interconnect element is covered with dielectric

materials (insulating layer) (for example, in electrophoresis), and carrying out protective coat generation follows on dielectric materials in the external layer of an electrical conducting material at them. By grounding an external electrical conducting material layer, the interconnect element as a result can be covered effectively and the impedance becomes controllable easily. (Please also refer to drawing 10 K of a parent example.) one voice of this invention -- if it depends like, an interconnect element can be beforehand manufactured for the installation after an electronic component. Various kinds of techniques for attaining this purpose are indicated by this specification. Although not specifically protected with this document, it is thought that it is [in / an elastomer] also comparatively clear as mounting to the substrate of two or more interconnect elements of each or an alternative to manufacture the machine which treats the suspension of two or more interconnect elements of each on a support substrate.

[0046] I hear that the compound interconnect element of this invention differs from the interconnect element of the conventional technique which strengthened the electric conduction property, or was covered in order to strengthen the corrosion resistance dramatically, and please understand clearly has it.

[0047] It means specifically that the protective coat of this invention strengthens substantially conclusion of the interconnect element to the terminal of an electronic component, and/or gives a desired restoration property to the compound interconnect element as a result. Stress (contact force) is turned [absorbing stress and] to the part of the interconnect element meant specifically.

[0048] Moreover, I hear that this invention essentially for manufacturing spring structure offers a new technique, and please recognize has it. Generally, the structure of the spring as a result of operation is bending and not the product of shaping but the product of plating. A door is opened by this to use of various kinds of "easy" processes for attaching in an electronic component the extensive ingredient which establishes a spring configuration, and the "scaffold" of a core. A protective coat functions as "supramolecular structure" covering the "scaffold" of a core, and the both mean having those zeros in the field of civil engineering.

[0049] A probe element does not need the ingredient of additions, such as brazing and soldering or soldering, but the unique advantage of this invention is in the point which can carry out direct manufacture on the terminal of the substrate component of the spacing converter of a probe card assembly.

[0050] one voice of this invention -- any of the contact structure which has stability if it depends like -- although -- it is formed as at least two compound interconnect elements.

[0051] Other purposes of this invention, the description, and the advantage will become clear in view of the following detailed descriptions.

[0052]

[Embodiment of the Invention] Reference is made by the detail to the suitable example of this invention, and the example is shown in the accompanying drawing. Although this invention is explained in relation to these suitable examples, not meaning limiting the pneuma of this invention and the range to the example of these specification should understand.

[0053] This patent application aims at a probe card assembly, its component, and the method of using them. Although it becomes clear from the following detailed explanation, in order to bring about pressure connection to the terminal of an electronic component, it is essential to use contact structure with stability. Contact structure with stability is suitably carried out as a "compound interconnect element", it applies on May 26, 1995 and this is indicated by the United States patent application 08th / indication of No. 452,255 ("parent example") which is incorporated on these specifications as reference and which was mentioned above. This patent application summarizes some of techniques indicated by parent application in the publication of drawing 15 and drawing 6 -14.

[0054] When the mechanical property of the compound interconnect element as (1) result is established and (2) interconnect elements are mounted in one terminal of an electronic component, in order that the important mode of this invention may conclude an interconnect element certainly for the terminal A "compound" interconnect element begins with a core (mounted in the terminal of an electronic component), and is in the point which can be formed by

subsequently generating a protective coat to a core with a suitable ingredient. Thus, it is fabricated easily to the configuration in which elastic deformation is possible, and an interconnect element (spring element) with stability can be manufactured by starting with the core of the elasticity ingredient easily attached even in the brittlest part of an electronic component. If a spring element is formed from hard material and an example is easily taken in the conventional technique which is not [that it is not clear and] intuitive possible [demonstration], the elasticity ingredient can form the fundus of a spring element. A this "compound" interconnect element is contact structure which generally has the stability of a suitable gestalt although used for the example of this invention.

[0055] Generally drawing 1 , and 2, 3 and 4 show various kinds of configurations for compound interconnect elements where this invention was followed.

[0056] Henceforth, the compound interconnect element which presents stability is mainly explained. However, I hear that a compound interconnect element without stability also goes within the limits of this invention, and please understand has it.

[0057] Furthermore, henceforth, the compound interconnect element by which protective coat generation is carried out with a hard (elasticity) ingredient and which has an elasticity (it is fabricated easily and is easy to fix according to user-friendly process to electronic component) core is mainly explained. However, a core can sometimes be used as hard material within the limits of this invention, and a protective coat mainly functions on an electronic component as concluding an interconnect element certainly.

[0058] In drawing 1 , the core 112 of "elasticity" ingredient (for example, ingredient which has yield strength fewer than 40,000psi), and the shell (protective coat) 114 of a "hard" ingredient (for example, ingredient which has bigger yield strength than 80,000psi) are contained in the electric interconnect element 110. A core 112 is an expanding element fabricated as a in general straight cantilever (configuration), and can be used as the wire which has the diameter of 0.0005 to 0.0030 inches (0.001 inches = 1 mil ** 25 microns (micrometer)). Shell 114 is crossed to the already fabricated core 112, and is given according to the suitable process of arbitration, such as a suitable plating process (for example, electrochemistry plating).

[0059] Drawing 1 shows the straight cantilever by which orientation was carried out at a certain include angle to the spring configuration considered to be the probably easiest configuration to the interconnect element of this invention, i.e., the force applied in the tip 110b, "F." when this force is applied with the terminal of the electronic component in which the interconnect element is carrying out pressure contact, according to the deviation (seeing by a diagram) to the lower part at a tip, clearly, as a result, a tip crosses a terminal and moves -- namely, -- "-- it wipes and becomes" movement. This thing [that wipe and good contact of dependability is made between an interconnect element and the contact terminal of an electronic component by contact] is guaranteed.

[0060] It is the favor of the "hard nature", and shell 114 gives desired stability to the interconnect element 110 whole by controlling the thickness (0.00025 to 0.00500 inches). Thus, interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 110a and 110b of the interconnect element 110. (In drawing 1 , reference number 110a shows the end of the interconnect element 110, and the actual edge which countered edge 110B is not shown.) In case the terminal of an electronic component is contacted, the interconnect element 110 will receive contact force (pressure) as shown by the arrow head written by "F."

[0061] Although an interconnect element (for example, 110) will answer the contact force applied and it will deviate, this deviation (stability) is partially determined by the thickness of a protective coat ingredient with the whole interconnect element configuration partially [yield strength / of a protective coat (as opposed to yield strength of core) ingredient / superior (it is big)].

[0062] Vocabulary called the "cantilever type" and the "cantilever" which are used on these specifications is mounted in an end (immobilization), and expanding structure (for example, core 112 with a protective coat) usually answers the force of acting on a longitudinal direction in general to the longitudinal direction shaft of an expanding element, and moves the other end

freely. By use of these vocabulary, the restrictive semantics with specific or others which means transfer or a hint does not have anything.
[0063] In drawing 2 , the elasticity core 122 (it is equal to 112) and the hard shell 124 (it is equal to 114) are similarly contained in the electric interconnect element 120. In the case of this example, a core 122 is fabricated so that it may have two bends, therefore it is considered that it is the shape of serpentine. Like the example of drawing 1 , interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 120a and 120b of the interconnect element 120. (In drawing 2 , reference number 120a shows the end section of the interconnect element 120, and the actual edge which countered edge 120b is not shown.) In case the terminal of an electronic component is contacted, the interconnect element 120 will receive contact force (pressure) as shown by the arrow head written by "F."
[0064] In drawing 3 , the elasticity core 132 (it is equal to 112) and the hard shell 134 (it is equal to 114) are similarly contained in the electric interconnect element 130. In the case of this example, a core 132 is fabricated so that it may have one bend, and it can be considered that it is a U character configuration. Like the example of drawing 1 , interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 130a and 130b of the interconnect element 130. (In drawing 3 , reference number 130a shows the end section of the interconnect element 130, and the actual edge which countered edge 130b is not shown.) In case the terminal of an electronic component is contacted, the interconnect element 130 can receive contact force (pressure) as shown by the arrow head written by "F." As an alternative, the interconnect element 130 can be used, and as shown by the arrow head written by "F'", it can also contact except the edge 130b.
[0065] Drawing 4 shows other examples of the warehouse connection element 140 with stability which has the elasticity core 142 and the hard shell 144. In the case of this example, the interconnect element 140 is essentially an easy cantilever type (it is equal to drawing 1), and curved tip 140b receives the contact force "F" which acts on a longitudinal direction to that longitudinal direction shaft.
[0066] Drawing 5 shows other examples of the interconnect element 150 with stability which has the elasticity core 152 and the hard shell 154. In the case of this example, the interconnect element 150 is a C typeface "-like" in general, and as it has the tip which curved slightly suitably and is shown by the arrow head written by "F", it is suitable for making pressure contact.
[0067] I hear that understand can form an elasticity core in the configuration which answers the force applied at the tip at the configuration in which the elastic deformation of arbitration is possible, and the existing stable interconnect element, and is made to deflect elastically easily if it puts in another way, and it has it. For example, a core can also be formed in an idiomatic coil configuration. However, a coil configuration originates in the bad influence of the overall length of an interconnect element, the inductance (in addition to this) relevant to it, and the inductance to the circuit which operates by the RF (rate) and is not desirable.
[0068] The ingredient of at least one layer of shell or multilayer shell (it explains below) has yield strength sharply higher than the ingredient of a core. Therefore, in case shell establishes the mechanical property (for example, elasticity) of the interconnect structure as a result, it makes the shadow of a core thin. At least 2:1 is suitable for the ratio of the yield strength of a shell pair core, and can also make it high to about 10:1 also including at least 3:1 and at least 5:1. Moreover, even if shell or multilayer shell has little clear one, the external layer should be made conductivity and its shell is remarkable in a wrap case in the edge of a core. (However, the example in which the edge of a core is exposed to a parent example is indicated, and a core must be conductivity in that case.) Only the thing done for protective coat generation with hard material from a scientific viewpoint at the spring operation (spring configuration) part of the compound interconnect element as a result is the need. Generally it is not essential to both two edges of this viewpoint to a core to carry out protective coat generation. However, as a practical question, it is desirable to the whole core to carry out protective coat generation. The advantage produced in an electronic component at the end of a conclusion (cling) **** core in the specific reason for carrying out protective coat generation and it is further discussed in a detail below.
[0069] Although it is not limitation, gold, aluminum, copper, and those alloys are contained in the

ingredient suitable for a core (112, 122, 132, 142). Although these ingredients are usually alloyed with a small amount of ingredients of other in order to acquire a desired physical property, they are beryllium, cadmium, silicon, magnesium, and others. It is also possible to use the metal or alloys of an element of silver, palladium, platinum, and the platinum group, such as a metal. Lead, tin, an indium, a bismuth, cadmium, antimony, and the solder that consists of those alloys are usable.

[0070] Generally field opposite installation (it discusses in a detail further below) of the end of the core (wire) to the terminal of an electronic component is the wire of the ingredient (for example, gold) of the arbitration which is easy to carry out bonding (for bonding to be brought about using temperature, a pressure, and/or ultrasonic energy), and this is suitable for carrying out this invention. It is also within the limits of this invention that the ingredient containing a nonmetal material of the arbitration which is easy to carry out protective coat generation (for example, plating) can use it for a core. Into the ingredient suitable for shell (114, 124, 134, 144) Although it is not limitation, nickel and its alloy, (It discusses below about each layer of multilayer shell like) Copper, cobalt, iron and those alloys, and gold (especially hard gold) and silver that present the current conveyance capacity for both to have stood high, and a good contact resistance property, The element of the platinum group, noble metals, half-noble metals and those alloys especially the elements of the platinum group and those alloys, a tungsten, and molybdenum are contained. When solder-like finishing is a request, tin, lead, a bismuth, indiums, and those alloys can also be used.

[0071] The technique chosen in order to give these covering material over various kinds of core materials indicated above changes according to the thing of a non-theory, and an application. Generally electrolytic plating and electroless deposition are suitable techniques. However, generally plating over a golden core is not intuitive. When plating the shell of nickel over a golden core (electroless deposition is carried out especially), in order to make plating initiation easy according to one mode of this invention, it is desirable to give the initiation layer of thin copper over a golden wire stem first.

[0072] An instantiation interconnect element as shown in drawing 15 has the core diameter of about 0.001 inches, and 0.001 inches shell thickness, therefore an interconnect element has about 0.003 inches diameter of the whole (namely, twice as many core diameter **** [as this] shell thickness). Generally, this thickness of shell becomes about 0.2 to 5.0 (from 1/5 to 5) twice the thickness (for example, diameter) of a core.

[0073] Some instantiation-parameters about a compound interconnect element are as follows.

[0074] (a) The wire core of the gold which has the diameter of 1.5 mils is fabricated so that it may have the abbreviation C character-like curve (it is equal to drawing 5) of the overall length of 40 mils, and a 9-mil radius, it is plated with 0.75-mil nickel (diameter =of the whole1.5+2x0.75=3 mil), and receives the 50-microinch golden last protective coat as ** and arbitration. The compound interconnect element as a result presents the spring constant (k) of about 3 - 5g/mil. At the time of use, a 3 to 5-mil deviation serves as 9 - 25g contact force as a result. This example is useful in relation to the spring element for insertion objects.

[0075] (b) The wire core of the gold which has the diameter of 1.0 mils is fabricated so that it may have the overall length of 35 mils, it is plated with 1.25-mil nickel (diameter =of the whole1.0+2x1.25=3.5 mil), and receives the 50-microinch golden last protective coat as ** and arbitration. The compound interconnect element as a result presents the spring constant (k) of about 3g/mil, and is useful in relation to the spring element for probes.

[0076] (c) The wire core of the gold which has the diameter of 1.5 mils is fabricated so that it may have the letter curve with an overall length [of 20 mils], and a radius of about 5 mils of the abbreviation for S characters, and it is plated with 0.75-mil nickel or copper (diameter =of the whole1.5+2x0.75=3 mil). The compound interconnect element as a result is useful in relation to the spring element for showing the spring constant (k) of about 2 - 3g/mil, and mounting on a semiconductor device.

[0077] Below, as further shown in a detail, a core does not need to have a round cross section, and it can also consider as the flat tab (it has a rectangle cross section) rather extended from a sheet. The vocabulary the "tab" which uses "understand" on these specifications is not mixing

up with "TAB" (tape automation bonding).
[0078] Multilayer shell drawing 6 shows one example 200 of the interconnect element 210 mounted in the electronic component 212 with which a terminal 214 is formed. In the case of this example, in an end, bonding is carried out to a terminal 214 (attached), the elasticity (for example, gold) wire core 216 is constituted so that it may extend from a terminal and may have a spring configuration (it is equal to the configuration shown in drawing 2), and it is cut so that it may have ** and free-end 216b. Thus, the bonding of a wire, shaping, and cutting are attained using wirebonding equipment. The adhesives in edge 216a of a core cover only the comparatively small part on the front face of exposure of a terminal 214.
[0079] Shell (protective coat) is arranged over the wire core 216, and in the case of this example, it is shown as multilayering, and has a inner layer 218 and an outer layer 220, and the layer of those both is appropriately given according to a plating process. One or more layers of multilayer shell are formed from hard material (nickel, its alloy, etc.), and desired stability is given to the interconnect element 210. for example, an outer layer 220 can be used as hard material, and in case a inner layer plates hard material 220 on core materials 216, it can use it as the ingredient which functions as a barrier layer and a binder layer or -- as a buffer or a barrier layer. As an alternative, a inner layer 218 can be used as hard material, and it can also consider as the ingredient which presents the outstanding electrical characteristics which include conductivity and soldering possibility for an outer layer 220 (elastic gold etc.). When contact of solder or brazing-and-soldering form is a request, the outer layer of an interconnect element can be made into the charge of a lead-tin solder or golden-tin wax tie, respectively.
[0080] Conclusion drawing 6 to a terminal shows in the gross that it can conclude for the terminal on an electronic component certainly [the other important descriptions of this invention, i.e., an interconnect element with stability,]. Attachment edge 210a of an interconnect element receives large mechanical stress as a result of the compressive force (arrow head "F") applied to free-end 210b of an interconnect element.
[0081] For a protective coat (218 220), the whole exposure front face of the remainder (namely, except adhesives 216a) of the terminal 214 which adjoins a core (have no interruption) 216 not only the core 216 but in succession [as shown in drawing 6] is also a wrap. The interconnect element 210 is concluded with dependability certainly and sufficient for a terminal by this, and a protective coat ingredient contributes substantially (for example, more greatly than 50%) to conclusion of the interconnect element as a result of a terminal by it. Generally, the thing which is the need is only that a protective coat ingredient covers some terminals [at least] which adjoin a core. However, as for a protective coat ingredient, generally, it is desirable to cover the whole remaining front face of a terminal. Suitably, each class of shell is metallicity.
[0082] As a general proposal, the comparatively small field where a core is attached in a terminal (adhesion) is seldom suitable for absorbing the stress produced from the contact force ("F") imposed on the compound interconnect element as a result. Shell is concluded certainly [the whole interconnect structure] for a terminal by wrap favor in the whole (except for the comparatively small field in which core edge 216a to a terminal is attached) exposure front face of a terminal. The bond strength of a protective coat and the capacity to react to contact force are farther [than that of the core edge (216a) itself] high.
[0083] Although it is not limitation, interconnect and an insertion substrate, the suitable semiconductor wafer made from a semiconductor material and suitable die of arbitration, such as silicon (Si) or gallium arsenide (GaAs), a generation interconnect socket, a trial socket, a sacrifice member, an element and a substrate that are indicated by the parent example, a ceramic, a plastic package and the semiconductor package containing a chip carrier, and a connector are contained in the vocabulary the "electronic component" (for example, 212) used on these specifications.
[0084] The interconnect element of this invention is suitable for using as the following especially enough. That is, they are the interconnect element which does not need to have - semiconductor package and is directly mounted in a silicon die, the interconnect element extended as a probe from a substrate (it explains to a detail further below) in order to examine - electronic component, and the interconnect element of - insertion object (it discusses in a detail

further below).
[0085] The interconnect element of this invention does not look at a kind in that the benefit of the mechanical property (for example, high yield strength) of hard material is received, without restricting it with the usually poor bonding property of accompanying of hard material. This becomes greatly possible according to the fact that shell (protective coat) functions as "supramolecular structure" over the "scaffold" of a core as stated to the parent example in detail. Here, these two vocabulary is borrowed from the environment of civil engineering. Generally it differs very much from the impossible plating-ized interconnect element of the conventional technique that plating is used as protection (for example, corrosion-proof) covering, and this gives a desired mechanical property to interconnect structure. moreover, nonmetallic corrosion-proof covering of arbitration of the benzotriazol (BTA) given to the interconnect section with this electric -- a certain kind -- it is remarkably contrastive.
[0086] In many advantages of this invention, since two or more independence interconnect structures are easily formed on a substrate to the common height on a substrate from the different level, such as PCB which has a decoupling capacitor, those free end has an advantage of coplanar ****** mutually. Furthermore, it doubles easily electrically [the interconnect element formed according to this invention] to the application of specification [both mechanical (for example, plastic and elasticity) properties]. For example, in a given application, it is desirable that an interconnect element presents plastic and elastic deformation. (The thing with desirable plastic deformation is for absorbing the total non-plane nature in the component which interconnects with an interconnect element.) When elastic behavior is a request, it is required for an interconnect element to generate the contact force of the minimum threshold dose, and to bring about good contact of dependability. Moreover, an advantage originates in the contamination film existing accidentally on a contact front face, and the tip of an interconnect element has it also in the point of wiping with the terminal of an electronic component and contacting.
[0087] The vocabulary which uses on these specifications and is applied to contact structure "there is stability" answers the added load (contact force), and the contact structure (interconnect element) which presents mainly elastic behavior is meant, and the vocabulary of "being obedient" answers the added load (contact force), and the contact structure (interconnect element) which presents both elastic and plastic behavior is meant. "Obedient" contact structure which is used on these specifications is contact structure "with stability." The compound interconnect element of this invention is obedient, or is one special case of the contact structures with stability.
[0088] The step which manufactures an interconnect element on a sacrifice substrate although many descriptions are stated to the parent example at the detail and it is not limitation, In order to make the step which carries out the package imprint of two or more interconnect elements, the step which establishes the contact tip which is coarse surface finish suitably in an interconnect element, and connection temporary and eternal subsequently in an electronic component at an electronic component The step which uses an interconnect element on an electronic component, and the step arranged so that it may have spacing in an end which is different from spacing in those opposite edges in an interconnect element, So that the difference by the thermal expansion between the components connected with the step which manufactures an interconnect element, and the step which manufactures a spring clip and an alignment pin at the step of the same process may be absorbed The step which uses an interconnect element, the step which abolishes the need for the semiconductor packages (SIMM etc.) according to individual, and the step which solders an interconnect element (contact structure with stability) with stability as arbitration are included.
[0089] Controlled impedance drawing 7 shows the compound interconnect element 220 which has a multilayer. the innermost section (internal long and slender electric conduction element) 222 of the interconnect element 220 described above -- as -- a non-covered core -- or it is either of the cores by which protective coat generation has already been carried out. The mask of the tip 222b of the innermost section 222 is carried out with a suitable masking material (un-illustrating). A dielectric layer 224 is given over the innermost section 222 according to an

electrophoretic process etc. The outer layer 226 of an electrical conducting material is given over a dielectric layer 224.
[0090] An interconnect element will have the controlled impedance as a result by grounding an outer layer 226 electrically at the time of use. The instantiation-ingredients for dielectric layers 224 are polymeric materials, and it is the suitable method of arbitration and they are given to the suitable thickness (for example, 0.1 to 3.0 mils) of arbitration.
[0091] An outer layer 226 can be made into a multilayer. For example, in the example whose innermost section 222 is a non-covered core, when it is a request that the whole interconnect element presents stability, at least one layer is a spring material among outer layers 226.
[0092] Pitch modification drawing 8 shows the example 250 in which the interconnect element 251--256 of plurality (illustration many inside six pieces) is mounted on the front face of the electronic components 260, such as probe card insertion (subassembly mounted in a probe card by the idiomatic method). The terminal of probe card insertion and electric conduction trace are omitted from this drawing for clear-izing of illustration. The attachment edge of the interconnect element 251--256 starts in the 1st pitch (spacing) of 0.05 - 0.10 inches. the interconnect element 251--256 serves as the 2nd detailed pitch of 0.005 - 0.010 inches in those free end (tip) -- as -- shaping -- and/or, orientation is carried out. The interconnect assembly which interconnects from a certain pitch to another pitch is usually called a "spacing converter."
[0093] Like illustration, it is tip 251b of an interconnect element. -- Although 256b is arranged by seriate [two / parallel], this is for making the semiconductor device which has two parallel trains of for example, an adhesion pad (contact) contact (at the time of a trial and/or aging). Although an interconnect element can be arranged so that it may have other tip putters, this is for making the electronic component which has other contact patterns, such as an array, contact.
[0094] Although only one interconnect element is generally shown through the example indicated by this specification, this invention can manufacture two or more interconnect elements, and can apply them also to the thing [say / a circumference pattern or a rectangle array pattern] for which two or more interconnect elements of each other by regular space relation are arranged.
[0095] Mounting of the direct interconnect element to the terminal of the use electronic component of a sacrifice substrate was explained above. Speaking in the gross, manufacture or mounting on the suitable front face of the arbitration of the suitable substrate of the arbitration containing a sacrifice substrate being possible for the interconnect element of this invention.
[0096] Although it observes a parent example, to this, as separate and unique structure for mounting of the consecutiveness for example, to an electronic component The publication about drawing 11 A-11F which manufacture two or more interconnect structures (for example, contact structure with stability), And two or more interconnect elements are mounted in a sacrifice substrate (carrier), and there is a publication about drawing 12 A-12C which, subsequently to an electronic component, imprints two or more interconnect elements in a bundle.
[0097] Drawing 9 -11 shows the technique for manufacturing two or more interconnect elements which carried out tip structure using a sacrifice substrate.
[0098] Drawing 9 shows the 1st step of technique 250, and the patternizing layer of a masking material 252 is given on the front face of the sacrifice substrate 254. Being able to use the sacrifice substrate 254 as thin (1 to 10 mils) copper or aluminium foil as an example, a masking material 252 serves as a common photoresist. In the locations 256a, 256b, and 256c which ask for manufacture of an interconnect element, the masking layer 252 is patternized so that it may have opening of plurality (illustration many inside three pieces). Locations 256a, 256b, and 256c are this semantics, and are equal to the terminal of an electronic component. Locations 256a, 256b, and 256c are suitably processed in this phase, and have a coarse or characteristic surface pattern. Like illustration, this is mechanically attained in locations 256a, 256b, and 256c by the mold push fixture 257 which forms a hollow in a foil 254. It is also possible to etch the front face of the foil in three locations chemically as an alternative, so that it may have a surface pattern. The technique of the arbitration suitable for bringing about this general purpose is within the limits of this invention, for example, are sand blasting, a peening, and others.
[0099] Next, the conductive tip structure 258 of plurality (illustration many inside one) is formed

in each location (for example, 256b) as shown in drawing 10. This is attained using a suitable technique of arbitration, such as electrolytic plating, and includes the tip structure of having a multilayer ingredient. for example, the thin (for example, 10 - 100 microinches) barrier layer of the nickel with which tip structure 258 is given on a sacrifice substrate -- elastic gold is continuously thin (for example, 10 microinches) -- continuing -- the thin (for example, 20 microinches) layer of hard gold -- it has the comparatively thick (for example, 200 microinches) layer of nickel, and the thin (for example, 100 microinches) last layer of elastic gold continuously. Generally, the 1st thin barrier layer of nickel is prepared, in order that the layer of consecutive gold may prevent "decomposing" with the ingredient (for example, aluminum, copper) of a substrate 254, the comparatively thick layer of nickel is for giving reinforcement to tip structure, and the last film of elastic gold gives the front face pasted up easily. This invention is not limited to any specific examples of the approach of forming tip structure on a sacrifice substrate. Because, these specific examples are for changing inevitably according to an application.

[0100] it is shown in drawing 10 -- as -- the core 260 of the plurality for interconnect elements (illustration many inside one) -- for example, it is formed on the tip structure 258 of either of the techniques which carry out bonding of the elastic wire core to the terminal of the above-mentioned electronic component. Next, protective coat generation is suitably carried out with hard material 262 by the above-mentioned method, subsequently a masking material 252 is removed, and as a result, a core 260 serves as the independence interconnect element 264 of plurality (illustration many inside three) mounted in the front face of a sacrifice substrate, as shown in drawing 11.

[0101] The protective coat ingredient 262 as well as a wrap protective coat ingredient concludes a core 260 for the field which was explained in relation to drawing 6 and where the terminal (214) adjoined at least certainly in those tip structures 258 of corresponding, and, in a request, a restoration property is given to the interconnect element 262 as a result. As annotated with the parent example, the package imprint of two or more interconnect elements mounted in a sacrifice substrate is carried out at the terminal of an electronic component. Two paths which branched extensively can also be taken as an alternative.

[0102] It is also within the limits of this invention that being able to use a silicon wafer as a sacrifice substrate and tip structure's being manufactured on it and the tip structure manufactured such can connect with contact structure with the stability already mounted in the electronic component (for example, soldering, brazing and soldering).

[0103] As shown in drawing 12, the sacrifice substrate 254 is simply removed by the suitable process of arbitration, such as selectivity chemical etching. Since almost all selectivity chemical etching etches one ingredient by the quite bigger ratio than the ingredient of another side and small deer etching of the ingredient of another side is not carried out at that process, the thin barrier layer of the nickel in tip structure is removed by removal and coincidence of a sacrifice substrate, using this phenomenon advantageously. However, if required, a thin nickel barrier layer is removable also at a consecutive etching step. As a result, it is dispersed to each of plurality (illustration many inside three), and becomes the unique interconnect element 264, and this is shown by the dotted line 266 by this, and the terminal on an electronic component is equipped later (soldering or brazing and soldering).

[0104] moreover -- reference should be made -- a protective coat ingredient is the process which removes a sacrifice substrate and/or a thin barrier layer, and is the point of being slightly made thin. However, it is more desirable for this not to arise.

[0105] In order to prevent thin smallness-ization of a protective coat, it is desirable that about 10-microinch elastic gold given over a golden film or about 20-microinch hard gold is given as the last layer over the protective coat ingredient 262. Generally the outer layer of this gold has high impermeability to almost all the etching solution that means the outstanding conductivity, contact resistance, and soldering possibility, and mainly meant using for removal of a barrier layer and a sacrifice substrate.

[0106] As an alternative, as shown in drawing 13, it precedes with removal of the sacrifice substrate 254, and the suitable supporting structure 266 of arbitration, such as a thin plate with which the interconnect element 264 of plurality (illustration many inside three) has two or more

holes inside, "is fixed" due to a mutual space request, and a sacrifice substrate is removed based on it. The supporting structure 266 can be used as the electrical conducting material by which protective coat generation is carried out with dielectric materials or dielectric materials. Further processing step called the step which equips electronic components, such as a silicon wafer or a printed circuit board, with two or more interconnect elements advances next. In addition, in some applications, it is desirable to stabilize so that the tip (tip structure was countered) of the interconnect element 264 may not move, and especially this is the case where contact force is applied there. It is the suitable sheet 268 which has two or more holes [say / the mesh in which desirable one was formed from dielectric materials] since it is this purpose, and is giving constraint to migration of the tip of an interconnect element.

[0107] Tip structure (258) is formed from the ingredient of a request of arbitration as a matter of fact, and the unique advantage of the above-mentioned technique 250 is in the point of having the pattern of a request of arbitration as a matter of fact. As mentioned above, gold is an example of noble metals which presents the electrical characteristics of conductivity, low contact resistance, soldering possibility, and corrosion resistance which stood high. Since gold is forgeability again, it is suitable for considering as the last protective coat given over either an interconnect element given in this specification, especially an interconnect element with stability given in this specification enough [very]. Other noble metals present a desirable property similarly. However, generally some ingredients which present these electrical characteristics that stood high, such as a rhodium, are not suitable to carry out protective coat generation at the whole interconnect element. For example, a rhodium is remarkably weak and does not fully function as the last protective coat on an interconnect element with stability. The technique represented by technique 250 conquers this limit easily about this. For example, the 1st layer of multilayer tip structure (see 258) can be made into a rhodium (not being gold as mentioned above), and thereby, in order to contact it in an electronic component, without having effect of what on any mechanical behavior of the interconnect element as a result, it pulls out the outstanding electrical characteristics.

[0108] Drawing 14 shows the alternative example 270 for manufacturing an interconnect element. In the case of this example, a masking material 272 is given to the front face of the sacrifice substrate 274, and like the technique described above about drawing 9 , it is patternized so that it may have the opening 276 of plurality (illustration many inside one). Opening 276 specifies the field by which an interconnect element is manufactured as a free standing structure. (That the interconnect element used for this specification through explanation of a publication is "independence") it is the case where bonding of the end is carried out to a field with the terminal of an electronic component, or a sacrifice substrate, and bonding of the other end is not carried out to an electronic component or a sacrifice substrate. As shown 278 by the single hollow extended in the front face of the sacrifice substrate 274, encaustic processing of the field in opening is carried out by the suitable method of arbitration so that it may have one or more hollows.

[0109] Bonding of the core (wire stem) 280 is carried out to the front face of the sacrifice substrate in opening 276, and it has the suitable configuration of arbitration. In this illustration, only the end of one interconnect element is shown for clear-izing of instantiation. The other end (un-illustrating) is attached in an electronic component. In that direct bonding of the core 280 is carried out to the sacrifice substrate 274 instead of the tip structure 258, I hear that seeing easily here differ in the technique 250 which technique 270 mentioned above, and there is. As an example, bonding of the golden wire core (280) is easily carried out to the front face of an aluminum substrate (274) using an idiomatic wirebonding technique.

[0110] At the next step of a process (270), it is given on the exposed region of the substrate 274 in opening 276 with which the golden layer 282 covers a core 280, and includes the inside of a hollow 278 (for example, plating). the main purposes of this layer 282 are forming a contact front face in the edge of the interconnect element as a result, when a sacrifice substrate is removed namely,.

[0111] Next, the layer 284 of comparatively hard ingredients, such as nickel, is given over a layer 282. As mentioned above, one main purpose of this layer 284 is giving a desired mechanical

property (for example, stability) to the compound interconnect element as a result. In this example, other main purposes of a layer 284 are strengthening the endurance on the front face of contact manufactured by the edge (it is illustration like) with the lower interconnect element as a result. Although the golden last layer (un-illustrating) will be given over a layer 284, this is for strengthening the electrical characteristics of the interconnect element as a result.
[0112] an interconnect element with plurality in the last step, a masking material 272 and the sacrifice substrate 274 are removed, and unique as a result (it is equal to drawing 12) — or it becomes either of two or more interconnect elements (it is equal to drawing 13) which has predetermined space relation mutually.
[0113] This example 270 is a typical technique for manufacturing the contact tip of encaustic processing at the edge of an interconnect element. In this case, an example in which the "golden overlay of nickel" contact tip excelled was explained. However, it is also within the limits of this invention for other similar contact tips to be able to manufacture at the edge of an interconnect element according to the technique of a publication to these specifications. A contact tip has another description of this example 270 in the point constituted by not the inside of the front face of a sacrifice substrate (254) which was meant in the former example 250 but the whole crowning of a sacrifice substrate (274).
[0114] Generally the technique of the introduction above of a mediation object explains a new technique for manufacturing a compound interconnect element, and the physical characteristic is easily doubled so that the stability of a desired degree may be shown.
[0115] Generally, the compound interconnect element of this invention is easily mounted in the substrate which functions as a mediation object (manufacture), a mediation object is arranged between two electronic components, they are interconnected and one of two electronic components is arranged in each ** of a mediation object. The manufacture and use of a congestion interconnect element in a mediation object are indicated by the United States patent copending application 08th by these above-mentioned people / No. 526,426 at the detail.
[0116] Generally the above-mentioned technique explains a new technique for manufacturing a compound interconnect element, the physical characteristic is easily doubled so that the stability of a desired degree may be shown, and generally the above-mentioned technique explains the capacity to manufacture a mediation object, using this compound interconnect element.
[0117] Generally, the compound interconnect element of this invention is easily mounted in a substrate, as the tip of an interconnect element is arranged that the field (for example, adhesion pad) where the semiconductor device was chosen should be contacted (manufacture).
[0118] The parent example is indicating the various techniques for applying a probe to a semiconductor device.
[0119] In the mediation object, the meaning using the interconnect element of this invention was expressed above. Generally, the "mediation object" used for this specification is a substrate, it has contact on the two front faces which countered, it is arranged between two electronic components, and the two electronic components are interconnected. Occasionally, it is desirable for a mediation object to make possible at least one of two interconnect elements (to for example, exchange, updating, and others sake).
[0120] Mediation object example #1 drawing 15 shows one example 300 of the mediation object which used the interconnect element of this invention. Generally, in the insulating substrates 302, such as a substrate of PCB form, the conductive through hole (for example, plated Bahia) 306 of plurality (illustration many inside two), and 308 and others are prepared, and the each has in them the conductive part exposed in up (above) surface 302a of an insulating substrate 302, and lower (below) surface 302b.
[0121] One pair of elasticity cores 311 and 312 are attached in the exposed part of a through hole 306 in up surface 302a of a substrate 302. One pair of elasticity cores 313 and 314 are attached in the exposed part of a through hole 306 in the lower front face of a substrate 302. Similarly, one pair of elasticity cores 315 and 316 are attached in the exposed part of a through hole 308 in the up front face of a substrate 302, and one pair of elasticity cores 317 and 318 are attached in the exposed part of a through hole 308 in the lower front face of a substrate 302. Next, protective coat generation of the core 311-318 is carried out with hard material 302, and

the interconnect structures 322 and 324 are formed in up surface 302a of a substrate 302, and the interconnect structures 326 and 328 are formed in lower surface 302b of a substrate 302. Thus, each core 311-318 is certainly concluded by the exposed part to which a through hole corresponds, and the interconnect structure 322 is electrically connected to the interconnect structure 326, and the interconnect structure 324 is electrically connected to the interconnect structure 328. when understand here establishes each interconnect structure (for example, 322) as one pair of interconnect elements (311 for example, 312), connection with still more sufficient dependability with an external component (un-illustrating) brings -- having (namely, a single interconnect element -- using -- also depending) -- it is saying.

[0122] Like illustration, all of the up group of the interconnect elements 311, 312, 315, and 316 are formed in the same configuration, and all the lower groups of an interconnect element also have the same configuration. Please understand can prepare the lower group of an interconnect element a different configuration from the up group of an interconnect element, and, thereby, the interconnect structure extended from the lower front face of a substrate is that an opportunity to make the interconnect structure extended from the up front face of an insulating substrate of having a different mechanical property is given.

[0123] Mediation object example #2 drawing 16 shows other examples 330 of the mediation object which used the interconnect element of this invention. In the case of this example, the interconnect element 332 of plurality (illustration many inside one) is manufactured by the pattern (for example, array) of a request on a sacrifice substrate (un-illustrating). Two or more holes 336 are similarly established in the support substrate 334 by the corresponding pattern. The support substrate 334 is arranged over the interconnect element 332 so that the interconnect element 332 may extend through a hole 336. With the suitable ingredients 338 (elastomer etc.) filled up with a hole 336, an interconnect element is loosely held within a support substrate, and is extended from both the upper part of a support substrate, and a lower front face. Next, a sacrifice substrate is removed. Although it is clear, the support substrate 334 (it is equal to 266) "can be dropped" simply in the process which manufactures this mediation object assembly on two or more interconnect elements (it is equal to 264) mounted in a sacrifice substrate (254).

[0124] Mediation object example #3 drawing 17 shows other examples 360 of the mediation object which used the interconnect element of this invention. Although this example 360 is similar to the example 330 explained above, it removes the point that the interconnect structure 362 (it is equal to 332) is supported by soldering the pars intermedia of the interconnect structure 362 to the plating section 368 on the through hole 366 of a support substrate in the hole 366 (it being equal to 336) of the support substrate 364 (it is equal to 334). Too, the support substrate 364 (it is equal to 266) "can be dropped" simply in the process which manufactures this mediation object assembly on two or more interconnect elements (it is equal to 264) mounted in a sacrifice substrate (254).

[0125] Drawing 16 and 17 are instantiation of the fact that single connection of the terminal with which two electronic components correspond can be brought about using a single interconnect element (332 362). It is also understood here instead of the interconnect element of this invention as shown in drawing 16 and 17 that the electric conduction element of arbitration can be used, and it is within the limits of this invention.

[0126] In drawing 15 and the mediation object example of 16 and 17, that an electronic component (un-illustrating) is arranged in the both sides of a mediation object (300, 330, 360) in order that a mediation object may make electrical installation between the terminal (un-illustrating) should understand.

[0127] Explanation of the interconnect element from a sheet of the formation above mainly narrowed down the target from the elasticity wire core and the wire core whose hard protective coat is an example of representation and by which shaping and protective coat generation were carried out to the approach of forming a compound interconnect element in general. This invention is applicable also to the method of forming the interconnect element formed from the metal sheet with which it is patternized in order to form a metal sheet and the flat expanding element (tab) by which is an elasticity metal sheet suitably, and is fabricated and protective coat

generation is suitably carried out with hard material (****** or etching) again. These contents are explained by the above-mentioned United States patent application 08th / No. 526,246 in full detail.
[0128] drawing 15 -17 explained **** on the spacing converter is applicable to this invention -- it is (suitable) -- the technique for manufacturing a mediation object and them is indicated. Although the compound interconnect element of this invention was explained, it should mainly understand clearly that the interconnect element (spring) which has the stability of arbitration including the spring structure manufactured from the monolithic ingredient essentially manufactured with elasticity from phosphor bronze and beryllium copper is usable.
[0129] "Spacing conversion" (occasionally called "a pitch escape") is an important concept applicable to this invention. If it says simply, what the tip of contact structure with stability approaches more nearly mutually than connection with those fundi, and spacing can be opened for (comparatively detailed pitch) is important. As shown in drawing 8 explained above, this can be attained by giving the inclination to have the die length from which molding and the contact structure which carries out orientation, and is completed mutually, consequently has each stability differ each spring element (251-256). Generally, in relation to a probe card assembly, all the probe elements (contact structure with stability) have the same die length mutually, and it is very important that fixed nature is guaranteed in two or more signal paths needed.
[0130] Drawing 18 shows the typical design of the spacing converter 400 according to this invention, and desired spacing conversion is attained by not molding of contact structure (un-illustrating) with each stability attached but the substrate 402 of a spacing converter.
[0131] The spacing converter substrate 402 is suitably formed as a multilayer component which has up (seeing by a diagram) surface 402a and lower (seeing by a diagram) surface 402b, and has the intersection alternation of strata of an insulating material (for example, ceramic) and an electrical conducting material. In the case of this example, one wiring layer is illustrated so that the two electric conduction (many inside) traces 404a and 404b may be included.
[0132] The terminals 406a and 406b of plurality (illustration many inside two) are arranged in up surface 402a of the spacing (approaching comparatively mutually) converter substrate 402 in a comparatively detailed pitch. The terminals 408a and 408b of plurality (illustration many inside two) are arranged in lower surface 402b of the spacing (separating from each other further to Terminalsa [406] and 406b) converter substrate 402 in a comparatively coarse pitch. For example, the lower terminals 408a and 408b are arranged in the pitch (it is equal to constraint of a printed circuit board) of 50 to 100 mils, can arrange the up terminals 406a and 406b in the pitch (it is equal to center-to-center spacing of the adhesion pad of a semi-conductor die) of 5 to 10 mils, and serve as 10:1 pitch conversion as a result. The up terminals 406a and 406b are connected to the lower terminals 408a and 408b which connect a terminal to the electric conduction traces 404a and 404b and which correspond, respectively by the conductors 410a/412a related, respectively and 410b/412b, respectively. Generally this is common knowledge altogether in relation to a multilayer land grid array (LGA) support substrate and others.
[0133] Probe card assembly drawing 19 shows one example of the probe card assembly 500, and this is suitable for making temporary interconnect to a semiconductor wafer 508 as the main functional component including the probe card 502, the mediation object 504, and the spacing converter 506. In the sectional view of this disassembly and assembly, some elements of some components are exaggerated and shown for clear-izing of instantiation. However, the alignment of the perpendicular direction (it is illustration like) of various kinds of components is appropriately shown by the dotted line of a drawing. Please mind is a point by which the interconnect element (514, 516, 524, and these are further explained to a detail below) is shown partially and completely.
[0134] Generally, a probe card 502 is the idiomatic circuit board, and has the surface of action (terminal) 510 of plurality (illustration many inside two) arranged in the up (seeing by a diagram) front face. The further component (un-illustrating), for example, activity, and a passive electronic component, a connector, and others can also be mounted in a probe card. The terminal 510 on the circuit board is usually arranged in the pitch (a pitch is specified above) of 100 mils. A probe

card 502 is appropriately roundish and has the diameter of about 12 inches.
[0135] A substrate 512 (it is equal to a substrate 302) is contained in the mediation object 504. The interconnect element 514 which has the stability of plurality (illustration many inside two) as mentioned above It is mounted in the lower (seeing by a diagram) front face of a substrate 512 (those juxtaposition edges). **, The interconnect element 516 which extends in a lower part (seeing by a diagram) from there, and has the corresponding stability of plurality (illustration many inside two) is mounted in the up (seeing by a diagram) front face of a substrate 512 (those juxtaposition edges), and extends from ** and there to the upper part (seeing by a diagram). any of an above-mentioned spring configuration -- although -- it is suitable for the interconnect elements 514 and 516 with stability which are compound interconnect elements of this invention suitably. As a general proposal, among the interconnect elements 514 and 516, the tip (distal end) of both the bottom plurality 514 and the top plurality 516 is a pitch which is in agreement with the pitch of the terminal 510 of a probe card 502, for example, is 100 mils.
[0136] The interconnect elements 514 and 516 are shown by the exaggeration scale for clear-izing of instantiation. Typically, the interconnect elements 514 and 516 will be extended even from the lower part and the up front face where the mediation object substrate 512 corresponds to 20 to 100-mil whole length. Generally, the height of an interconnect element is decided from the magnitude of desired compliance.
[0137] The substrate 518 (it is equal to above 402) circuit-ized appropriately is contained in the spacing converter 506. This for example It is a multilayered ceramic substrate and has the terminal (a surface of action, pad) 520 of plurality (illustration many inside two) arranged in the bottom (seeing by a diagram) front face, and the terminal (a surface of action, pad) 522 of plurality (illustration many inside two) arranged in the top (seeing by a diagram) front face. In the case of this example, two or more lower contact pads 520 are arranged in the pitch (for example, 100 mils) at the tip of the interconnect element 516, and two or more upper contact pads 522 are arranged in a more detailed (it approached) pitch (for example, 50 mils). Although the interconnect elements 514 and 516 with these stability are suitable, they do not necessarily need to be compound interconnect elements (it is equal to above 210) of this invention.
[0138] the interconnect element 524 (a "probe" --) with the stability of plurality (illustration many inside two) A "probe element" is direct () to a terminal (contact pad) 522. Namely, the wire which connects a probe element to a terminal does not have the vector which consists of an additional ingredient. or a terminal -- a probe element -- brazing and soldering -- it is mounted, without soldering (those juxtaposition edges), and extends to the upper part (seeing by a diagram) from the up (seeing by a diagram) front face of the spacing converter substrate 518. Like illustration, those tips (distal end) can open spacing in a pitch (for example, 10 mils) still more detailed than those juxtaposition edges, and thereby, the interconnect element 524 with these stability is appropriately arranged so that pitch reduction of the spacing transducer 506 may be reinforced. Although the contact structure (interconnect element) 524 with these stability is suitable, it does not necessarily need to be the compound interconnect element (it is equal to above 210) of this invention.
[0139] a probe element (524) is manufactured on a sacrifice substrate (it is equal to drawing 9 - 11), and mounts in the terminal (522) of a spacing converter component (506) separately continuously -- having (it being equal to drawing 12) -- or it is within the limits of this invention for what is done for a package move (it is equal to drawing 13) to be also possible for these terminals.
[0140] As everyone knows, phot lithography, deposition, diffusion, and two or more other die sites formed more are included in a semiconductor wafer 508 on the anterior part (it sees by a diagram and is the bottom) front face. Typically, similarly these die sites are manufactured mutually. However, some die sites may serve as a malfunction in accordance with the fully established trial criteria as a result as everyone knows according to one of the defects in either of the processes which the defect of the wafer itself or a wafer wears to formation of a die site. Before simplifying a semi-conductor die from a semiconductor wafer, it originates in attendant difficulty applying a probe to a die site, and a trial process is often carried out, after simplifying and mounting a semi-conductor die. When a defect is discovered after mounting of a semi-

conductor die, net loss gets worse by the costs which accompany mounting of a semi-conductor die. Although a semiconductor wafer has the diameter of at least 6 inches, it is usually included no less than at least 8 inches.
[0141] Each die site usually has many surfaces of action (for example, adhesion pad), and these can be arranged by the pattern of the location of the arbitration on the front face of a die site, and arbitration. The two one adhesion (many inside) pad 526 in a die site is shown in the drawing.

[0142] Before simplifying a die site to each semi-conductor die, in order to examine a die site, the technique of the number of limitation is known. It is embedded by the technique of the typical conventional technique at a ceramic substrate, manufacture of the probe card insertion which has two or more tungstens "a needle" extended from there follows on it, and each needle makes temporary connection to the given pad of the adhesion pads. Lead time although manufactured, complicated [this probe card insertion is expensive, and / a little] and considerable although those costs become comparatively high as the result and they are obtained will start. When the adhesion pad of various many ways which are possible in a semi-conductor die is given, unique probe card insertion is needed for the array of each ****.
[0143] The speed which manufactures a peculiar semi-conductor die is a short duration, and makes conspicuous the urgent demand to a probe card simple, although manufactured, and cheap. As probe card insertion, using a spacing converter (506) and a mediation object (504) copes with this demand that cannot be inhibited head-on. At the time of use, the mediation object 504 is arranged in the up (seeing by a diagram) front face of a probe card 502, and the spacing transducer 506 is accumulated on the crowning (seeing by a diagram) of 504 besides mediation so that the pressure contact with the contact pad 520 of the spacing transducer 506 and dependability the interconnect element 514 makes the pressure contact with the sufficient contact terminal 510 of a probe card 502 and dependability, and sufficient [the interconnect element 516] may be made. These components are accumulated, although the pressure contact with this sufficient dependability is guaranteed, the device of suitable arbitration can be used, and the suitable device is explained to it below.
[0144] The probe card assembly 500 contains the following main components, in order to accumulate the mediation object 504 and the spacing transducer 506 on a probe card 502. Namely, the regions-of-back mounting plate 530 made from an ingredient with strong stainless steel etc., Plurality containing the actuator mounting plate 532 made from an ingredient with strong stainless steel etc., the anterior part mounting plate 534 made from an ingredient with strong stainless steel etc., the external differential screw element 536, and the internal differential screw element 538 (although it is two of many in illustration) The mounting ring 540 which three are suitably manufactured from an ingredient with a differential screw [being suitable] and elasticity, such as phosphor bronze, and has one pattern of a tab (un-illustrating) with the elasticity extended from there, As the screw 542 of the plurality (illustration many inside two) for holding the mounting ring 540 with the spacing transducer 506 caught among them by the anterior part mounting plate 534, and arbitration, in order to absorb manufacture tolerance It is the pivot ball 546 of plurality (illustration many inside two) arranged by the mounting ring 540, the spacer ring 544 arranged between the spacing transducers 506, and the crowning (seeing by a diagram) of a differential screw (for example, crowning of the internal differential screw element 538).
[0145] The regions-of-back mounting plate 530 is the metal plate or ring (it illustrates as a ring) arranged in the lower (it is illustration like) front face of a probe card 502. The hole 548 of plurality (illustration many inside one) extends through a regions-of-back mounting plate.
[0146] The actuator mounting plate 532 is the metal plate or ring (it illustrates as a ring) arranged in the lower (it is illustration like) front face of the regions-of-back mounting plate 530. The hole 550 of plurality (illustration many inside one) extends through an actuator mounting plate. At the time of use, the actuator mounting plate 532 is the suitable method of arbitration with a screw (from the drawing, omitted for clear-izing of instantiation) etc., and is fixed to the regions-of-back mounting plate 530.
[0147] the anterior part mounting plate 534 is strong — it is a metaled ring suitably. It is the

suitable method of arbitration with the screw (from the drawing, omitted for clear-izing of instantiation) which penetrates the corresponding hole (omitted from the drawing for clear-izing of instantiation) where the anterior part mounting plate 534 minded the probe card 502 at the time of use. It is fixed to the regions-of-back mounting plate 530, and a probe card 502 is certainly caught by it between the anterior part mounting plate 534 and the regions-of-back mounting plate 530.

[0148] The anterior part mounting plate 534 has the flat lower (seeing by a diagram) front face arranged to the up (seeing by a diagram) front face of a probe card 502. the anterior part mounting plate 534 has big central opening through it like illustration, and this is prescribed by dimension arrangement **** and the internal edge 552 that two or more contact terminals 510 of a probe card 502 should make it possible that it is in central opening of the anterior part mounting plate 534.

[0149] As mentioned above, the anterior part mounting plate 534 is the ring-like structure of having a flat lower (seeing by a diagram) front face. It distinguishs between the up (seeing by a diagram) front face of the anterior part mounting plate 534, and the anterior part mounting plate is thick (it sees by a diagram and is vertical magnitude) in the external field rather than the contrant region on it. a level difference or a shoulder is arranged in the location of a dotted line (it writes by 554), and the spacing converter 506 removes the external field of an anterior part mounting plate, and appears on the contrant region of the anterior part mounting plate 534 -- possible -- it should carry out -- dimension arrangement **** (however, although it thinks that it understands, a spacing converter appears on the pivot ball 546 in fact).

[0150] The hole 554 of plurality (illustration many inside one) minds the anterior part mounting plate 534 partially at least. It extends to the external field of the anterior part mounting plate 534 (these holes are shown with the drawing that it extends without minding the anterior part mounting plate 534 partially), and these receive the edge of two or more corresponding screws 542 from the up (seeing by a diagram) front face like understanding. Because of this purpose, a hole 554 is a chasing hole. It becomes possible to fix to an anterior part mounting plate in the mounting ring 540, therefore to press the spacing transducer 506 to a probe card 502 by this.

[0151] Alignment of the hole 558 of plurality (illustration many inside one) is carried out to the corresponding hole 560 of the plurality (illustration many inside one) which extends completely through the thick contrant region of the anterior part mounting plate 534, and is extended through a probe card 502, and alignment is carried out to the hole 548 in a regions-of-back mounting plate, and the hole 550 in the actuator mounting plate 538 at order.

[0152] The pivot ball 546 is loosely arranged within the adjusted hole 558 and 560 in an edge on the internal differential screw element 538 (seeing by a diagram). It lets the external differential screw element 536 pass into the hole (chasing) 550 of the actuator mounting plate 532, and lets the internal differential screw element 538 pass into the chasing boa of the external differential screw element 536. Thus, very detailed adjustment can be made in the location of each pivot ball 546. For example, the external differential screw element 536 has the external screw thread of 72 screws / inch, and the internal differential screw element 538 has the external screw thread of 80 screws / inch. Location change of the net of a corresponding pivot ball becomes "plus" 1/72 (0.0139) inch "minus" 1 / 80 (0.0125) inches, i.e., 0.0014 inches, by advancing one rotation and the external differential screw element 536 into the actuator mounting plate 532, and maintaining the internal differential corresponding screw element 538 at a quiescent state (facing the actuator mounting plate 532). By this, the easy and precise adjustment of the smoothness of the spacing converter 506 which carried out field opposite is attained at a probe card 502. Therefore, repositioning at the tip (it sees by a diagram and is upper limit) of a probe (interconnect element) becomes possible, without changing the orientation of a probe card 502. The importance of the alternative device (means) for adjusting this description, the technique for carrying out alignment at the tip of a probe, and the smoothness of a spacing converter is further explained to a detail below in relation to drawing 25. Although it is clear, it is the favor of obedient contact structure and the mediation object 504 guarantees the thing which is the stability arranged in two front faces of a mediation object and for which electrical installation is maintained between the spacing transducer 506 and a probe card 502 through the adjustable

range of a spacing transducer, or it is.
[0153] The probe card assembly 500 is simply assembled by the following steps. Namely, the tip of the interconnect element 514 so that the contact terminal 510 of a probe card 502 may be contacted The step which arranges the mediation object 504 in the opening 552 of the anterior part mounting plate 534, and the tip of the interconnect element 516 so that the contact pad 520 of the spacing converter 506 may be contacted The step which arranges the spacing converter 506 in the upper part of the mediation object 504, and the step which is an arbitration step and arranges a spacer 544 in the crowning of the spacing converter 506, The step which arranges the mounting ring 540 over a spacer 544, A spacer 544 is minded for the screw 542 through the mounting ring 540. The arbitration step containing the step inserted into the hole 554 of the anterior part mounting plate 534, Through the regions-of-back mounting plate 530 and a probe card 502 by inserting a screw (one being partially illustrated as a sign 555) into the chasing hole (un-illustrating) in the lower (seeing by a diagram) front face of the anterior part mounting plate 534 It is the step which mounts a "subassembly" in a probe card 502.
[0154] Subsequently to the regions-of-back mounting plate 530 the actuator mounting plate 538 is attached (with for example, screw with which one of them is partially illustrated as 556), the pivot ball 560 is dropped into the hole 550 of the actuator mounting plate 532, and the differential screw elements 536 and 538 can insert into the hole 550 of the actuator mounting plate 532.
[0155] Thus, in order to bring about a probe card assembly, for this to be a detailed pitch corresponding to today's adhesion pad spacing, to precede with simplification of the die from a semiconductor wafer and to make two or more adhesion pads on a semi-conductor die (surface of action) contact, it has contact structure (524) with two or more stability extended from an assembly. Generally, to the time of use, it will be used for an assembly 500 for the bottom from the place of illustration, turning down, and a semiconductor wafer is made at it the tip of contact structure (524) with stability (external device which is not illustrated).
[0156] The anterior part mounting plate (base plate) 534 determines the location of a probe card 502 and the mediation object 504 of field opposite so that clearly from a drawing. In order to guarantee exact positioning of the anterior part mounting plate 534 which carried out field opposite with the probe card 502, the pin to extend, two or more alignment descriptions (omitted from the drawing for clear-izing of illustration), for example, anterior part mounting plate, and the hole extended into a probe card 502 can be prepared.
[0157] It is also within the limits of this invention to use on the mediation object (504) with which contact structure (514, 516, 524) with stability with suitable arbitration contains the tab (ribbon) of brazing and soldering, or the phosphor bronze ingredient and others which are soldered in the surface of action on a mediation object or a spacing transducer, respectively, and/or a spacing transducer (506).
[0158] It is within the limits of this invention for reserve attachment to be also mutually possible by the spring clip which a mediation object (504) and a spacing converter (506) are indicated as an element 486 of drawing 29 of PCT/US 94/13373 of the coincidence connection by these people who mentioned above, and extend from a mediation object substrate.
[0159] It is also within the limits of this invention to mount directly contact structure with two or more stability which excludes a mediation object (504), instead is equal to 514 in the contact pad (520) on the front face of the bottom of a spacing converter. However, probably, it will be difficult to attain a coplanarity between a probe card and a spacing converter. The main functions of a mediation object are bringing about the compliance which guarantees this coplanarity.
[0160] Drawing 20 is the perspective view of the spacing converter substrate 518 suitable for the probe card assembly 500 of drawing 19. As shown there, the rectangular stereo with which the spacing converter substrate 518 has die length "L", width of face "W", and thickness "T" is suitable. Then, in this drawing, up surface 518a of the spacing transducer substrate 518 is visible, and the interconnect element (it is equal to 524) of probe inspection is mounted. Like illustration, the contact pad 522 of plurality (hundreds grade) is arranged in up surface 518a of the spacing converter substrate 518 in the predetermined field. This predetermined field is shown by the

dotted line written by 570, and the contact pad 522 can be arranged by the suitable pattern of arbitration in that predetermined field 570 so that clearly.
[0161] As mentioned above, the spacing converter substrate 518 is appropriately formed as a multilayered ceramic substrate, and has the intersection alternation of strata of a ceramic ingredient and the patternized electrical conducting material.
[0162] By the way, manufacture of this multilayered ceramic substrate has common knowledge, for example, is used in the case of manufacture of a land grid array (LGA) semiconductor package. By routing appropriately the electrical conducting material patternized within this multilayer substrate, the pitch of the contact pad 522 of up surface 518a of a substrate 518 is a different (for example, more large) pitch, and it is [arranging a contact pad (it being equal to 520, although it is not visible in this drawing) in the lower front face (it not being visible in this drawing) of a substrate 518, and the substrate 518 interior] clear mutually to connect the contact pad 520 with the contact pad 522. It is greatly realizable to attain the pitch of about 10 mils between the contact pad 520 and the contact pad 522 on this substrate.
[0163] Drawing 20 shows the suitable description of the spacing converter substrate 518. As mentioned above, a substrate 518 is a rectangle stereo which has up surface 518a, a lower front face (it is hiding from the field of view in this drawing), and four flank edges 518b, 518c, 518d, and 518e. flank edge 518a-518e to which Notches 572b, 572c, 572d, and 572e correspond like illustration along with the intersection of the corresponding flank edges 518b, 518c, 518d, and 518e and up surface 518a of a substrate 518 — along with whole length (the corner was removed), it is prepared mostly. Such notch 572b-572e makes manufacture of the spacing converter as multilayer ceramic structure in general easy, and is visible also to instantiation of drawing 19. I hear that a notch is not necessarily required and please understand here has it. Although it is clear, it is that without a notch (this is fundamentally shown by the process which manufactures the multilayer substrate of a ceramic), and a mounting plate (540 of drawing 19) needs to be clearly adapted for the "description" of these corners at four corners of a substrate 518.
[0164] Drawing 21 is equal to the spacing transducer 518 explained above, and shows one usable example of the spacing transducer 574 like the probe card assembly 500 of drawing 19. In this case, the fields 570a, 570b, 570c, and 570d of plurality (illustration many inside four) are specified, and two or more contact pads 522a, 522b, and 522c can be respectively arranged easily inside by that request pattern that is arbitration. The place meant in general, since field 570a-570d spacing is equivalent to spacing of the die site on a semiconductor wafer, it is the point in which the probe inspection to coincidence is possible about the single "pass" of a probe card about two or more die sites. (This is useful especially although a probe is applied to the memory chip of a large number on one semiconductor wafer.) Although the contact pad 522a-522d pattern with which it corresponds in field 570a-570d of a substrate 574 does not become the same mutually typically, this is not necessarily the need absolutely.
[0165] In order to apply a probe to the die site to which the plurality on a semiconductor wafer (for example, illustration four) adjoined the single spacing converter (pressure contact is made), it is proved [instantiation / of drawing 21] clearly that it is possible to prepare a probe element. This is advantageous to reduction of the number required to apply a probe to all the die sites on a wafer of set downs (step). For example, when 4 sets of probe elements exist 100 die sites and on a spacing transducer on one wafer, the things which are need at a wafer are only 25 positioning to a spacing transducer (noting that it is disregarded that the effectiveness in the edge (circumference) of a wafer declines a little for the purpose of this example). It is within the limits of this invention that it can optimize that the number of touchdown which needs not only the array of a probe site (for example, 570a-570d) but the orientation of each probe element (for example, it is alternate) to apply a probe to the whole wafer should be minimized. As a mutual probe element contacts the die site where the die sites of 2 next doors on a wafer differ, it is also within the limits of this invention for a probe element to be able to arrange on the front face of a spacing converter. Generally in the case of the premise of being desirable, it is clear that all probe elements have the same whole length, but the method of not receiving constraint that direct installation (mounting) also at what kind of point on the two-dimensional front face of a

spacing converter is possible for a probe element is superior to which technique which gives constraint to the anchoring location to the probe card of a probe element (for example, the above ring arrays). Thus, it is also within the limits of this invention that a probe is applied to the die site to which the plurality on one wafer does not adjoin. This invention is advantageous to especially the thing for which a probe is applied to the memory device by which it is not simplified on one wafer, and although a probe is applied to the die site which has the aspect ratio of arbitration, it is useful.

[0166] Drawing 22 shows the instantiation-layout of the contact pad 520 in the lower front face of the spacing converter substrate 518, a pad 520 is arranged by the pattern which has the pitch of 100 mils, and each train of a pad is made alternate from the contiguity train of a pad, and each pad has the diameter of about 55 mils.

[0167] Drawing 23 is the top view of either the instantiation up front face of the mediation object substrate 580 (it is equal to 512), or a lower front face, and shows the instantiation-layout of the electric conduction field (it is equal to drawing 19 at un-illustrating and drawing 15) where an interconnect element (514 516) is mounted. Drawing 24 is some sectional views of the same mediation object substrate 580. As shown in drawing 24, the through hole 582 where plurality was plated extends through a substrate 580 to surface 580b which counters from surface 580a of one of these. The substrate (plate) itself is formed from an idiomatic circuit board ingredient using an idiomatic technique for manufacturing the plated through hole. In the case of this example, the "base" substrate 584 is covered with the very thin (for example, 100 microinches) "blanket" layer 586 which is a copper layer in early stages. The photoresist layer 588 is given to both sides of a substrate, and it is patternized so that it may have opening which makes the plating riser of a through hole 582 possible. A through hole 582 is plated with about 1-mil thick copper layer, is crossed to this layer, and the thin (for example, at least 100 microinches) barrier layer 592 which is a layer of nickel deposits it, it is crossed to this layer, and the thin (for example, at least 50 microinches) layer 594 of elasticity (pure) gold deposits it. Next, the photoresist layer 588 is removed and the trace of the early very thin copper layer 586 is removed from the outside field of the plated through hole 582. As shown in drawing 23, the top view of each surface of action formed of the plated through hole 582 is a top view of a circular ring, and is equipped with one tab extended from there. This tab specifies the orientation of the electric conduction field (pad) of a through hole (to mounting of an interconnect element sake) exposed in the front face of a substrate 580. A pad is arranged in an alternate train with a pitch of 100 mils, and those orientation (determined by those tabs) is reversed in Chuo Line on the front face of a substrate.

[0168] The following dimensions and an ingredient are typical to a predetermined application about the above-mentioned instantiation probe card assembly 500.

[0169] a. The spacing transducer substrate 518 has at least three intersection alternation of strata which consists of die length (L) of 2.5 inches, width of face (W) of 2.5 inches, thickness (T) of 0.25 inches, and ceramics and the patternized conductors.

[0170] b. It is the compound interconnect element of this invention, and the interconnect element 524 extended from the **** converter substrate 518 has a golden wire core with a diameter of 1.0 mils, and protective coat generation of this is carried out with 1.5-mil nickel, and it serves as a 4.0-mil diameter of the whole. The overall length of the interconnect element 524 is 40 mils.

[0171] c. The mediation object substrate 512 is formed from an idiomatic circuit board ingredient, and has a 1.850 inches side dimension and the thickness of 16 mils.

[0172] d. It is the compound interconnect element of this invention, and the interconnect elements 514 and 516 extended from the mediation object substrate 512 have a golden wire core with a diameter of 1.0 mils, and protective coat generation of this is carried out with 1.5-mil nickel, and they serve as a 4.0-mil diameter of the whole. The overall length of the interconnect elements 514 and 516 is 60 mils.

[0173] Although the interconnect elements 514 and 516 are shown in drawing 19 as a single interconnect element Each element of illustration was explained above in relation to drawing 15. It carries out easily as one interconnect structure of having two or more interconnect elements.

It is within the limits of this invention that making the pressure contact with sufficient dependability to the contact pad 520 of the contact terminal 510 to which a probe card 502 corresponds, and the spacing converter 506 is guaranteed, and, generally it is suitable.
[0174] A spacing converter (506, 518, 574) and a mediation object (504 580) can supply "please understand clearly" to an end user as a "kit" (or "subassembly"), in that case, I hear that an end user will supply a probe card and related mounting hardware (for example, 530, 532, 534, 536, 538, 540, 544), and there is.
[0175] Although it set to a drawing and the above explanation and this invention has been illustrated and explained to a detail, this invention should be regarded not as the limitation in **** but as instantiation. That is, I hear that all deformation and corrections that enter in having illustrated and explained only the suitable example and the meaning of this invention are not protected desirably, either, and please understand here has them. it should also suspect -- it means that the modification those to whom there are not and other "modifications" of a large number about the above-mentioned "theme" belongs most near this invention, and who have the knowledge usual with the technique concerned hit on an idea of, which will come out and exist and which carries out and is indicated by this specification is within the limits of this invention. Some of these modifications are indicated by the parent example.
[0176] Alignment drawing 25 of a probe card assembly shows the technique 700 which carries out alignment of the probe card assembly of the probe card assembly 500 grade of drawing 19. For this purpose, some of elements of the probe card assembly 500 of drawing 19 have the same sign (5xx) in this drawing. Drawing 25 is the partial assembly drawing with which main components contacted mutually.
[0177] The problem which this invention copes with head-on is the point that it is common for it to be difficult to carry out alignment of the contact tip of a probe card (or probe card insertion) to the semiconductor wafer which it is going to examine. The tolerance about the coplanarity of the tip of a probe and the front face of a wafer is maintained at the minimum, in each tip 524a (it sees by a diagram and is upper limit) of each probe (namely, contact structure 524 with stability), it is uniform, and it is essential to guarantee the pressure contact with sufficient dependability. As explained above, the device (for example, differential screws 536 and 538) for adjusting the smoothness of tip 524a of a probe is prepared in a probe card assembly by making it operate based on the spacing transducer 506. In this drawing, as the spacing converter substrate 506 is shown in above-mentioned drawing 18, between that up terminal and lower terminal, internal connection is made and it is shown.
[0178] the semiconductor wafer with which the adjustment of the end of the probe is measured, and end-of-the-probe 524a will be offered following a probe card assembly if required before using a probe card assembly and carrying out the trial about a semiconductor wafer (that is, pressed to the end of the probe) -- ******** -- it is adjusted so that things may be guaranteed.
[0179] Generally, the wafer testing device with which a probe card assembly is mounted conveys a semiconductor wafer to a probe card assembly, and has a device (un-illustrating) for pressing a semiconductor wafer to end-of-the-probe 524a. For this purpose, a semiconductor wafer is held according to a chuck device (un-illustrating). For the purpose of this explanation, a testing device and a chuck device make it possible to move a wafer to the location and orientation which can be repeated [that it is precise and] one after another as an assumption. Here, the precise location of a wafer functions as "datum level."
[0180] If field opposite is carried out with the orientation where a semiconductor wafer is expected according to this invention and it puts in another way, in order to carry out field opposite with datum level and to carry out alignment of the tip 524a, the flat electric conduction metal plate 702 is mounted in a testing device instead of a semiconductor wafer. The flat metal plate 702 functions as "substitution" wafer or a "virtual" wafer for the purpose of carrying out alignment of the tip 524a of a probe.
[0181] Each probe 524 is related with one terminal in two or more terminals on a probe card 502 (un-illustrating), and the electric conduction path between them is constituted by the wiring layer in one as which it was chosen of the probes 524, one to which it relates of the contact

structures 516 with stability selected, one to which it relates of the contact structures 514 with stability selected, and a probe card 502 (un-illustrating). A probe card terminal can be made into a surface terminal, the terminal of a socket, and other formats. A cable 704 connects between a probe card 502 and the computers (testing device) which have the display monitor 708. This invention is not limited to use of a computer apparatus, and use of a display monitor, either.
[0182] In this example, bringing about 100 pressure contact as an assumption between 100 ends-of-the-probe 524a arranged by the rectangle array of 10x10 and 100 terminals (for example, adhesion pad) of one wafer presupposes that it asks. However, this invention is not limited to the number of specification of the end of the probe, and the specific layout of an adhesion pad.
[0183] The flat metal plate 702 is supported by the chuck (un-illustrating), and is pressed to end-of-the-probe 524a (advanced as a declared "A" arrow head shows). a ******** [that this is performed comparatively gradually, consequently all end-of-the-probe 524a contacts all at once (it is unpromising) on a flat metal plate] -- or it can check whether some of end-of-the-probe 524a precedes with the remainder of end-of-the-probe 524a, and they are contacted with the flat metal plate 702. In illustration, as for 71 continuous tone circles in the field 710 on a monitor 708 (dot), 71 in end-of-the-probe 524a show that it is already in contact to the metal plate 702 flat before 29 pieces (it illustrates as a circle of a null) contact the metal plate 702 with the flat remainder of end-of-the-probe 524a. based on this visual expression, although it is clear, the spacing converter 506 (or probably metal plate 702) inclines toward a left (seeing by a diagram) lower part (drawing -- seeing -- the outside from a page), and it can get down (inclining) and it can adjust the orientation of the spacing converter 506 easily by suitable adjustment of the differential screws 536 and 538.
[0184] Adjustment required to attain the request target of all flat-surface coincidence contact of tip 524a with the flat metal plate 702 with which all of end-of-the-probe 524a contact the flat metal plate 702 substantially at coincidence, without changing the orientation of a probe card 502 is easily calculated with either online or off-line. By making the calculated adjustment, tip 524a of a probe 524 will contact substantially the adhesion pad on the semiconductor wafer which it is going to continue and examine at coincidence.
[0185] Experimental good / "no" (contact/non-contact) form in which it explained in the former paragraph show the 1st "position" alignment which becomes easy with the probe card assembly of this invention. 2nd "position" alignment is easily carried out by what a probe element tip records the sequence (sequence) in contact with a metal plate for (in for example, computer memory). Generally the first tip in contact with a metal plate needs to express and lower the corner of "it is high" and a spacing transducer too much (for example, thing for which a differential screw is adjusted). Similarly, the tip of the last in contact with a metal plate needs to express and raise the corner of "it is low" and a spacing transducer too much (for example, thing for which a differential screw is adjusted). In order to opt for adjustment with the need which should be made based on the sequence at the tip in contact with a metal plate, it is within the limits of this invention that it is usable in the suitable algorithm of arbitration. as the smeared-away circle to the circle which measures the resistance between each end-of-the-probe 524a and the flat metal plate 702 (for example, touch-down is received) and by which it is not only smeared away on the display monitor -- coming out -- the numeric value and notation with which there is nothing and the measured resistance is expressed, and a dot color -- or -- in addition to this -- ** -- although it can carry out and can display, generally this thing is not suitable.
[0186] If it puts in another way, in order [which adjusts the orientation of the spacing transducer 506] to carry out flattening of the tip 524a of a probe 524, it is within the limits of this invention that it is usable in the suitable device of arbitration. The alternative example of use of the differential screw (536 538) explained above will be using servo mechanism, a piezo-electric driving gear or an actuator, magnetostriction equipments, those combination, or others that attains this flattening (to for example, coarse control and fine control sake).
[0187] Drawing 26 shows the automation technique 750 for adjusting the space orientation of a spacing converter (un-illustrating here). In this example, it is replaced to a differential screw (536

538), and the actuator style 552 (it writes by "ACT") answers a signal from a computer 706, and operates. By three starting devices 552, three pairs of differential screw elements can be replaced simply clearly. The same sign looked at by drawing 25 is given to the similar element of drawing 26, and some elements looked at by drawing 25 are excluded from the field of view of drawing 26 for clear-izing of illustration.

[0188] It is also within the limits of this invention for it to be able to arrange besides the device (automation device especially shown in drawing 26) for carrying out flattening showing a spacing converter (506) to this specification at the typical example of a publication. For example, it is able for a suitable device to be able to arrange between the up (seeing by a diagram) front face of a probe card (502), and an anterior part mounting plate (534), or to incorporate in an anterior part mounting plate (534). The important description of using either of these devices does not need to change the orientation of a probe card (502), and is in the capacity that the include angle (orientation) of a spacing converter (506) can be changed.

[0189] Drawing 9 -11 explained by preliminary manufacture of the tip structure for probe elements, processing of a probe element, and the connection above of the tip structure to a probe element is indicating the technique for manufacturing the compound interconnect element 264 on tip structure (258) for mounting to the terminal of an electronic component which manufactures tip structure (258) and continues on a sacrifice substrate (254). To be sure, this technique is usable in relation to mounting the compound interconnect element which has tip structure [finishing / manufacture] in the up front face of a spacing converter (518).

[0190] As contact structure with the stability in the crowning of a spacing converter, especially, drawing 27 shows the alternative technique 800 for manufacturing the compound interconnect element which has useful tip structure [finishing / manufacture], and explains this below. In this example, the silicon substrate (wafer) 802 which has an up (seeing by a diagram) front face is used as a sacrifice substrate. The layer 804 of titanium deposits on the up front face of a silicon substrate 802 (for example, sputtering), and has the thickness of about 250A (1A=0.1nm=10-10 m). The layer 806 of aluminum deposits on the crowning of the titanium layer 804 (for example, sputtering), and has the thickness of about 10,000A. The titanium layer 804 functions as a glue line being arbitrary and for aluminum layer 806. The copper layer 808 deposits on the crowning of the aluminum layer 806 (for example, sputtering), and has the thickness of about 5,000A. The layer 810 of a masking material (for example, photoresist) deposits on the crowning of a copper layer 808, and has the thickness of about 2 mils. The masking layer 810 is processed by the suitable method of arbitration, and has the hole 812 of plurality (illustration many inside three) extended to the copper layer 808 which is downward through the photoresist layer 810. For example, the diameter of each hole 812 can be made into 6 mils, and a hole 812 can be arranged in the pitch (between pin center,larges) of 10 mils. The sacrifice substrate 802 is carried out in this way, and is prepared to manufacture of two or more multilayer contact tips in the following holes 812.

[0191] By plating etc., the layer 814 of nickel deposits on a copper layer 808, and has the thickness of about 1.0 to 1.5 mils. It is also possible to deposit the film (un-illustrating) of noble metals called a rhodium on a copper layer before deposition of nickel as arbitration. Next, the golden layer 816 deposits on nickel 814 by plating etc. The multilayer structure of nickel and aluminum (rhodium as [And] arbitration) will function as tip structure [finishing / manufacture] (shown in 820 and drawing 28).

[0192] Next, as shown in drawing 28, exfoliation removal of the photoresist 810 is carried out (using the suitable solvent of arbitration), and two or more manufactured tip structures laid in the crowning of a copper layer 808 remain. Next, a copper layer (808) wears a rapid etching process, and the aluminum layer 806 exposes it by it. Since aluminum is a non-wettability substantially, it is useful in a consecutive step to solder and a wax ingredient, so that clearly.

[0193] here -- reference should be made -- patterning is carried out in the hole of addition of a photoresist, and it is desirable [that "substitution" tip structure 822 is manufactured at the same process step as being used for manufacture of the tip structure 820] in the hole. Such substitution tip structures 822 functioning as equalizing the above-mentioned plating step by the method been well-known and understood, and crossing the front face which a steep slope (non-

homogeneity) tends to plate by that cause, and appearing is reduced. This structure (822) is known for the field of plating as "rubber (robbers)."
[0194] Next, soldering or the brazing-and-soldering paste ("connection ingredient") 824 accumulates on the up (seeing by a diagram) front face of the tip structure 820. (It is not necessary to deposit a paste on the upper part of the substitution tip structure 822) This is carried out by a stainless steel screen or the stencil by the suitable method of arbitration. The typical paste (connection ingredient) 824 contains the golden-tin alloy in which a 1-mil ball (ball) is shown (to flux base material).
[0195] the contact structure in which the tip structure 820 has stability here — preparation of mounting (for example, brazing and soldering) to the edge (tip) of the compound interconnect element of this invention is completed suitably. However, it is desirable first, a compound interconnect element "is prepared" specially so that it may receive the tip structure 820.
[0196] Drawing 29 expects that tip structure (820) is mounted in the edge of the compound interconnect element 832, and the technique 850 for preparing the spacing converter 830 (it being equal to 506) equipped with the compound interconnect element 832 of plurality (illustration many inside two) is shown. The compound interconnect element (probe element) 832 is shown completely (not being a cross section).
[0197] In this example, it is a multilayer (it is equal to drawing 6), and the compound interconnect element 832 has a golden (wire) core, protective coat generation is carried out in a copper layer (un-illustrating), protective coat generation is further carried out in the layer of nickel (nickel-cobalt alloy which has the nickel:Co ratio of 90:10 suitably), and protective coat generation of it is further carried out in a copper layer (un-illustrating) at this. A nickel layer deposits only on a part with the large last thickness of the request (for example, 80%), and, as for few remaining parts (for example, 20%) of nickel thickness, depositing at the consecutive step explained below is desirable so that clearly.
[0198] In this example, the columnar structure 834 of plurality (illustration many inside two) extended from that up (seeing by a diagram) front face will be formed in the spacing converter substrate 830, and these will function on it as polish "a stop" so that clearly. It is not required to not necessarily have a majority of these polish stops, and they are easily formed from the same ingredient as a substrate (for example, ceramic).
[0199] Subsequently the spacing converter substrate 830 "is cast" in suitable casting ingredients, such as heat fusibility, a solvent fusibility polymer, etc. which extend from the up front face of a spacing converter substrate and which function as supporting compound connection element 832. This is made by the grinding wheel 838 grade pressed caudad (seeing by a diagram) to the up front face of for example, a casting ingredient although the up (seeing by a diagram) front face of the upper-cast substrate subsequently receives polish. The above-mentioned polish stop 834 determines the last location of a grinding wheel shown with the declared "P" chain line. thus, the tip (it sees by a diagram and is upper limit) of the compound interconnect element 832 grinds -- having -- mutual — substantial -- perfect -- ******** — **
[0200] In order that the tip of contact structure with stability making the semiconductor wafer which it is going to examine, and ******, and a tip may guarantee that flattening is carried out so that a wafer may be substantially contacted in coincidence as explained above, the device (for example, a differential screw or an automation device) which carries out orientation of the spacing transducer is prepared in the whole probe card assembly (500). Initiation in the tip as for which flattening is carried out to the clear thing by polish (or means of other arbitration) will contribute to attaining this important purpose. Furthermore, the constraint imposed on a mediation object component (534) in order to absorb the non-coplanarity in the tip of the probe element (832) extended from a spacing transducer component by guaranteeing the coplanarity at the tip of a probe element (832) although it is what (compliance) can soften (it decreases).
[0201] After flattening at the tip of the probe element by polish is completed, the casting ingredient 836 is removed by the suitable solvent. (The polish stop 834 will be removed at this time.) A casting ingredient is the place of common knowledge as well as those solvents. It is within the limits of this invention that it is usable in order that casting ingredients which can

carry out melting removal simply, such as a wax, may also support a probe element (832) to polish. A spacing converter is carried out in this way, and it serves as a preparation completion so that it may receive above-mentioned tip structure (820).
[0202] The ingredient which carries out protective coat generation is removed by the golden wire stem (core) of the compound interconnect element 832 in a tip, and the secondary effectiveness with the benefit of a polish activity is in the point that a golden core is made into an exposure. As long as it is a request to carry out the brazing and soldering of the tip structure (820) at the tip of a compound interconnect element, it is desirable for the golden ingredient which should be carried out brazing and soldering to be exposed.
[0203] Although reference was already made, it is desirable by carrying out the plating step of one addition, namely, carrying out nickel plating of the compound interconnect element 832, and preparing a compound interconnect element in few parts (for example, 20%) of the remainder of the nickel total thickness of those requests "to prepare" the spacing converter for receiving tip structure further.
[0204] The prepared substrate which is shown in drawing 28 is supported on the prepared spacing converter here. As shown in drawing 30, the tip structure 820 (only two tip structures are shown for clear-izing of illustration) Alignment is carried out to the tip of the compound interconnect element 832 using a standard flip chip technique (for example, division prism). An assembly In order to carry out a reflow of the connection ingredient 824, it passes through a brazing-and-soldering furnace, and tip structure 820 beforehand manufactured by it is connected with the edge of contact structure 832 (for example, brazing and soldering).
[0205] It is within the limits of this invention for the contact structure which does not have stability in the tip structure manufactured beforehand using this technique, a compound interconnect element, and other connection (for example, brazing and soldering) to be possible.
[0206] At the time of a reflow process, it is prevented by the exposed aluminum layer (806) which is a non-wettability that solder (namely, wax) flows between the tip structures 820, namely, being formed between the tip structures where a solder bridge adjoins is prevented. In addition to this humid prevention function of an aluminum layer, an aluminum layer functions also as a release layer again. Using a suitable etching agent, etching removal of the aluminum is carried out in preference (as opposed to other ingredients of an assembly), and a silicon substrate 802 falls with "sufficient" vigor simply, and as a result, as shown in drawing 31, it serves as a spacing converter equipped with the compound interconnect element (probe element) which has the tip structure where preliminary manufacture of each was carried out. (it mind that the connection ingredient 824 be reflow end as a "fillet" in the edge of the probe element 832 here) etching removal of the residual copper (808) be carry out, and in order to make the terminal of the electronic component with which the nickel (or the above-mentioned rhodium) of the tip structure 820 tend to apply a probe contact, it be leave behind by the exposure in the last step of a process.
[0207] Generally it is not desirable to be able to manufacture first on the tip structure of the very thing, then for it to be able to mount in a spacing converter substrate by "pneuma" of the technique which explained the compound interconnect element (832nd grade) in relation to drawing 9 -11 using the tip structure metallurgical method explained in relation to drawing 27, although it is within the limits of this invention.
[0208] After excluding a brazing-and-soldering (soldering) paste, instead plating an eutectic ingredient (for example, golden-tin) on contact structure with stability, it is within the limits of this invention to mount a contact tip (820) in it.
[0209] Although it set to a drawing and the above explanation and this invention has been illustrated and explained to a detail, this invention should be regarded not as the limitation in **** but as instantiation. That is, I hear that all deformation and corrections that enter in having illustrated and explained only the suitable example and the meaning of this invention are not protected desirably, either, and please understand here has them. it should also suspect — it means that the modification those to whom there are not and other "modifications" of a large number about the above-mentioned "theme" belongs most near this invention, and who have the knowledge usual with the technique concerned hit on an idea of, which will come out and exist

and which carries out and is indicated by this specification is within the limits of this invention. Some of these modifications are indicated by the parent example.
[0210] For example, it sets to either of the examples indicated or suggested in this specification. Exposure in the light in which a masking material (for example, photoresist) is given to a substrate, and passes a mask, An alternative technique can also be used when patterning is carried out by chemical removal (namely, idiomatic HOTORISO graph technique) of the part of a masking material etc. and to it The light beam (from an excimer laser) appropriately made parallel is turned to the part of the masking material (for example, blanket hardening photoresist) which it is going to remove. By it Hardening the part of a masking material directly (** which does not use a mask), and washing a non-hardened masking material chemically subsequently by carrying out ablation of these parts of a masking material or the light beam appropriately made parallel, is included.
[0211] Although there are some compound interconnect elements of this invention, it is within the limits of this invention that it is one example of contact structure with suitable stability in which direct mounting for the terminal of the spacing converter component of a probe card assembly is possible. For example, it is within the limits of this invention that it is also possible to cover with solder or gold, to improve those soldering nature, and to support to the needle which consists of an ingredient which is called a tungsten, and which essentially has stability (comparatively high yield strength) by the desired pattern as arbitration, and to solder to it at the terminal of a spacing converter.
[0212]
[Effect of the Invention] Probe card assemblies (500) are a probe card (502) and a spacing converter (506), are directly mounted in the front face, and include the spacing converter (506) which has contact structure (probe element) (524) with the stability extended from the front face, a spacing converter (506), and the mediation object (504) arranged between probe cards (502). A spacing transducer (506) and a mediation object are "pile" **** so that the orientation of a spacing transducer (506), therefore the orientation at the tip of a probe element (524) can adjust without changing the orientation of a probe card. The suitable device (532, 536, 538, 546) for determining which about the orientation of a spacing converter (506) should be adjusted and should be adjusted is indicated. The technique of an indication is used for many size and sites on a semiconductor wafer (508), a probe is easily applied to them, and a probe element (524) can be arranged so that the probe reliance of the whole wafer (508) may be optimized. The compound interconnect element (200) which has the comparatively elastic core (206) in which protective coat generation was carried out by the comparatively hard shell (218 220) as contact structure with stability is indicated.
[0213] The technique for carrying out probe inspection of the semiconductor device by the configuration like the above, while especially they are on a semiconductor wafer is offered. Moreover, the technique for applying a probe to a semiconductor device made possible is offered, without changing the location of a probe card for the orientation at the tip of a probe element. The improved spring element (contact structure with stability) which can be directly mounted in the terminal of an electronic component is offered. The interconnect element suitable for furthermore making pressure contact to an electronic component is offered.

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TECHNICAL FIELD

[Field of the Invention] This invention is further preceded with mounting of a semiconductor device about making temporary pressure connection between electronic components at a detail, and suitably, before each semiconductor device is simplified from a semiconductor wafer, it relates to the technique for carrying out the trial and aging procedure about a semiconductor device.

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PRIOR ART

[Description of the Prior Art] This application is the United States patent (situation: pending in court) copending application 08th for which it applied on May 26, 1995 by the same applicant / No. 452,255 (henceforth). It is continuation application a part. it is called a "parent example" -- this United States patent application The United States patent (situation: pending in court) copending application 08th / No. 340,144 for which it applied on November 15, 1994 by the same applicant, And the correspondence PCT patent application number PCT/US 94/13373 (it announces publicly as WO 95/14314 on May 26, 1995) for which it applied on November 16, 1994 is continuation application a part. the United States patent (situation: pending-in-court/license) copending application 08th for which it applied on November 16, 1993 according [they] to the same application in both / No. 152,812 -- it is continuation application a part.
[0003] the United States patent (situation: pending in court) copending application 08th for which it applied on September 21, 1995 according [this application] to the same applicant again / No. 526,246, and the United States patent (situation: pending in court) copending application 08th which applied on October 18, 1995 by the same applicant / No. 533,584 -- it is also continuation application a part.
[0004] Each semi-conductor (integrated circuit) component (die) is usually manufactured by making some same components on a semiconductor wafer using a known technique of phot lithography, deposition, and others. Before these processes simplify each die from a semiconductor wafer (cutting), they aim general at making two or more integrated circuit devices which function completely. However, it is not avoided in fact that the defect of a certain kind at the time of processing the physical defect of a certain kind in the wafer itself and a wafer of some of the dies is "good" (it functions completely), and some of the dies become the cause of being "wrong" (it not functioning). Generally it is desirable that it is discriminable before they are suitably simplified [which is good among two or more dies on a wafer and] from a wafer before those mounting. For this purpose, a wafer "a testing device" or "probe equipment" is used advantageously, and two or more discrete pressure connection is made to two or more discrete connection pads (adhesion pad) similarly on a die. Thus, it becomes possible to examine and operate a semi-conductor die, before simplifying a die from a wafer. The idiomatic component of a wafer testing device is a "probe card", two or more probe elements are connected to this, and the tip of a probe element brings about pressure connection to the adhesion pad with which a semi-conductor die corresponds.
[0005] It is the kimono which a certain kind of difficulty has in a semi-conductor die at which technique which applies a probe. For example, the latest integrated circuit contains the adhesion pad of the thousands arranged by approaching mutually (5 mils of for example, centers to center). Furthermore, the layout of an adhesion pad does not need to be limited to the single train of the adhesion pad arranged near the circumference edge of a die (see U.S. Pat. No. 5,453,583).
[0006] In order to bring about the pressure connection with sufficient dependability between a probe element and a semi-conductor die, it is necessary to make an issue of some parameters, and although it is not limitation, alignment, the probe force, an overdrive, contact force, the balanced contact force, washing, contact resistance, and flattening are contained in these.

Although the general argument of these parameters can be found out to U.S. Pat. No. 4,837,622 entitled "a high density probe card (HIGH DENSITY PROBE CARD)" and being incorporated on these specifications by considering this as reference, the high density epoxy ring probe card containing the unit type printed circuit board equipped with central opening which suited this patent so that the epoxy ring by which the probe element was preformed might be received is indicated.

[0007] Generally, two or more tungsten needles extended as a cantilever from one front face of a probe card are contained in the probe card assembly of the conventional technique. A tungsten needle is mounted in a probe card by agency of the above epoxy rings etc. by the suitable method of arbitration. Generally, in any case, a needle is wired by agency of the separate and unique wire which connects a needle to the terminal of a probe card at the terminal of a probe card.

[0008] A probe card is usually formed as a circular ring, and these are equipped with the probe element (needle) of hundreds (and the terminal of a probe card wires) extended from the inner circumference of a ring. a circuit module -- and equal electric conduction trace (line) of die length is suitably related with each of a probe element. According to this ring configuration layout, when the adhesion pad of each semi-conductor die is especially arranged except two straight-line arrays which met two opposite edges of a semi-conductor die, it becomes difficult to apply a probe to two or more semi-conductor dies (a large number site) with which it is not simplified on the wafer, and, in a certain case, it becomes impossible.

[0009] The probe film which has a central contact bump field can also be used for a wafer testing device as an alternative, and this is indicated by U.S. Pat. No. 5,422,574 entitled "the large-scale protrusion film for the semiconductor devices under the trial equipped with the number of super-** pins (LARGE SCALE PROTRUSION MEMBRANE FOR SEMICONDUCTOR DEVICES UNDER TEST WITH VERY HIGH PIN COUNTS)", and is incorporated on these specifications by considering this as reference. "A trial system consists of a probe card for usually maintaining exact mechanical contact for the trial controller for performing and controlling a series of test programs, the wafer distribution system for dealing with a wafer mechanically and positioning it as pretest preparation, and an examined component (DUT)" (the 1st paragraph, 41 to 46 lines) is indicated by this patent.

[0010] Although further bibliography is considered as reference and incorporated on these specifications, to these The technical condition in the trial of a semiconductor device is expressed. U.S. Pat. No. 5,442,282 "TESTING ANDEXERCISING INDIVIDUAL UNSINGULETED DIES ON A WAFER", said -- the 5,382,898th a number ("HIGH DENSITY PROBE CARD FOR TESTING ELECTRICAL CIRCUITS") -- said -- the 5,378,982nd a number ("TEST PROBE FOR PANEL HAVING AN OVERLYING PROTECTIVE MEMBERADJACENT CONTACTS") -- said -- the 5,339,027th a number ("RIGID-FLEX CIRCUITS WITH RAISED FEATURES AS IC TEST PROBE") -- said -- the 5,180,977th a number ("MEMBRANE PROBE CONTACT BUMP COMPLIANCY SYSTEM") -- said -- the 4,757,256th a number ("HIGH DENSITY PROBE CARD") -- said -- the 4,161,692nd a number ("PROBE DEVICE FOR INTEGRATED CIRCUIT WAFERS") -- and -- said -- the 3,990,689th A number ("ADJUSTABLE HOLDER ASSEMBLY FOR POSITIONING A VACUM CHUCK") is contained.

[0011] Generally, the interconnect between electronic components can be classified into the category of two wide senses called permanent ["relatively permanent"] and "immediately dismountable" interconnect.

[0012] There is a soldered joint as an example of "relatively permanent" connection. Once two components of each other are soldered, although these components are separated, it is necessary to use a solder removal process. Wire adhesion is other examples of "relatively permanent" connection.

[0013] As an example of "immediately dismountable" connection, there is a pin with one strong electronic component, and it is received with the elastic socket element of other electronic components. A socket element does the contact force (pressure) of sufficient magnitude to guarantee electrical connection with reliance between them to a pin.

[0014] The interconnect element aiming at making an electronic component and pressure

contact is called a "spring" or a "spring element" in this specification. Generally, bringing the pressure contact with sufficient (for for example, terminal on an electronic component) dependability to an electronic component is expected some minimum contact force. for example, guaranteeing making electrical connection with dependability sufficient for the terminal of the electronic component which is polluted with the film on a front face, and has corrosion or an oxidation product on a front face is expected about 15g (per contact -- being few -- 2g or less -- and and 150g or more is included) contact (load) force. To increase either the yield strength of a spring ingredient or the dimension of a spring element is needed for the minimum contact force required for each spring. As a general proposal, it becomes still more difficult to process it (for example, piercing bending etc.), so that the yield strength of an ingredient becomes high. And it essentially becomes impossible to manufacture those cross sections still more greatly by possibility of saying that he wants to manufacture a spring still smaller.

[0015] Especially a probe element is one classification of the spring element relevant to this invention. The probe element of the conventional technique is manufactured from a general comparatively hard tungsten (high yield strength). When it is a request to mount this comparatively hard ingredient in the terminal of an electronic component, processes comparatively "severe" (for example, elevated temperature), such as a brazing-and-soldering method, are needed. Generally this "severe" process is not desirable in relation to some electronic components comparatively "brittle", such as a semiconductor device, (it is unrealizable again in many cases). In contrast with it, it is an example of a process with wirebonding comparatively "easy", and this does not almost have doing damage to a brittle electronic component by the case than a brazing-and-soldering method. Soldering is other examples of a process comparatively "easy." However, solder and gold are both comparatively elasticity ingredients (low yield strength), and these do not fully function as a spring element.

[0016] Other delicate problems relevant to an interconnect element including spring contact are often in the point which does not have the terminal of an electronic component ******** completely. In order to absorb such "tolerance" (total coplanarity), the interconnect element which lacks in a certain device both incorporated will be pressed violently, and will make the pressure contact to which the terminal of an electronic component cohered.

[0017] Although incorporated on these specifications by considering the following United States patents as reference, these are mentioned to an electronic component considering making field opposite connection, especially pressure connection as a general problem. These United States patents U.S. Pat. No. 5,386,344 "FLEX CIRCUIT CARD ELASTOMERIC CABLE CONNECTOR ASSEMBLY", said -- the 5,336,380th a number ("SPRINGBIASED TAPERED CONTACT ELEMENTS FOR ELECTRICAL CONNECTORS AND INTEGRATED CIRCUIT PACKAGES") -- said -- the 5,317,479th a number ("PLATED COMPLIANT LEAD") -- said -- the 5,086,337th a number ("CONNECTING STRUCTURE OF ELECTRONIC PART AND ELECTRONIC DEVICE USING THE STRUCTURE") -- said -- the 5,067,007th a number ("SEMICONDUCTOR DEVICE HAVING LEADS FOR MOUNTING TO A SURFACE OF A PRINTED CIRCUIT BOARD") -- said -- the 4,989,069th a number ("SEMICONDUCTOR PACKAGE HAVING LEADS THAT BREAK-AWAYFROM SUPPORTS") -- said -- the 4,893,172nd a number ("CONNECTING STRUCTUREFOR ELECTRONIC PART AND METHOD OF MANUFACTURING THE SAME") -- said -- the 4,793,814th a number ("ELECTRICAL CIRCUIT BOARD INTERCONNECT") -- said -- the 4,777,564th a number ("LEADFRAME FOR USE WITH SURFACE MOUNTED COMPONENTS") -- said -- the 4,764,848th a number ("SURFACE MOUNTED ARRAY STRAIN RELIEF DEVICE") -- said -- the 4,667,219th a number ("SEMICONDUCTOR CHIP INTERFACE") -- said -- the 4,642,889th a number ("COMPLIANT INTERCONNECTIONAND METHOD THEREFOR") -- said -- the 4,330,165th a number ("PRESS-CONTACT TYPE INTERCONNECTORS") -- said -- the 4,295,700th a number ("INTERCONNECTORS") -- This 4,067,104th number () ["MEHOD] OF FABRICATING AN ARRAY OF FLEXIBLE METALLIC INTERCONNECTS FORCOUPLING MICROELECTRONICS COMPONENTS", said -- the 3,795,037th a number ("ELECTRICAL CONNECTOR DEVICE") -- said -- the 3,616,532nd a number ("MULTILAYER PRINTED CIRCUITELECTRICAL INTERCONNECTION DEVICE") -- and -- said -- the 3,509,270th It is a number ("INTERCONNECTION FOR PRINTED CIRCUITS AND

METHOD OF MAKING SAME").

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EFFECT OF THE INVENTION

[Effect of the Invention] Probe card assemblies (500) are a probe card (502) and a spacing converter (506), are directly mounted in the front face, and include the spacing converter (506) which has contact structure (probe element) (524) with the stability extended from the front face, a spacing converter (506), and the mediation object (504) arranged between probe cards (502). A spacing transducer (506) and a mediation object are "pile" **** so that the orientation of a spacing transducer (506), therefore the orientation at the tip of a probe element (524) can adjust without changing the orientation of a probe card. The suitable device (532, 536, 538, 546) for determining which about the orientation of a spacing converter (506) should be adjusted and should be adjusted is indicated. The technique of an indication is used for many size and sites on a semiconductor wafer (508), a probe is easily applied to them, and a probe element (524) can be arranged so that the probe reliance of the whole wafer (508) may be optimized. The compound interconnect element (200) which has the comparatively elastic core (206) in which protective coat generation was carried out by the comparatively hard shell (218 220) as contact structure with stability is indicated.
[0213] The technique for carrying out probe inspection of the semiconductor device by the configuration like the above, while especially they are on a semiconductor wafer is offered. Moreover, the technique for applying a probe to a semiconductor device made possible is offered, without changing the location of a probe card for the orientation at the tip of a probe element. The improved spring element (contact structure with stability) which can be directly mounted in the terminal of an electronic component is offered. The interconnect element suitable for furthermore making pressure contact to an electronic component is offered.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Especially one purpose of this invention is offering the technique for carrying out probe inspection of the semiconductor device, while their are on a semiconductor wafer.
[0019] Other purposes of this invention are offering the technique for applying a probe to a semiconductor device made possible, without changing the location of a probe card for the orientation at the tip of a probe element.
[0020] Other purposes of this invention are offering the improved spring element (contact structure with stability) which can be directly mounted in the terminal of an electronic component.
[0021] Other purposes of this invention are offering the interconnect element suitable for making pressure contact to an electronic component.

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MEANS

[Means for Solving the Problem] According to this invention, for a probe card assembly The probe card which has an up front face, a lower front face, and two or more terminals that can be set on the up front face (electronic component), Contact structure with two or more 1st stability extended from an up front face, a lower front face, and the terminal in the lower front face, And the mediation object which is extended from the terminal in the up front face and which has contact structure with two or more 2nd stability (electronic component), The spacing converter which is extended from an up front face, a lower front face, two or more contact pads (terminal) arranged in the lower front face, and the terminal in the up front face and which has contact structure (probe element) with the 3rd stability is contained.
[0023] A mediation object makes it possible to be arranged between the up front face of a probe card, and the lower front face of a spacing transducer, and to adjust the orientation (surface smoothness) of a spacing transducer, without changing the orientation of a probe card. The technique for determining the device suitable for bringing about adjustment of the orientation of this spacing converter and the orientation where a spacing converter is exact is indicated by this specification. Thus, the tip (distal end) of a probe element is adjusted and it becomes possible to guarantee the pressure contact with sufficient dependability between the tip of a probe element, and the adhesion pad (terminal) with which the semiconductor device by which probe inspection is carried out corresponds.
[0024] The contact structure which has two or more stability as an alternative is prepared in the lower front face of a spacing converter component (that is, manufactured on the terminal on the front face of lower of a spacing converter) in order to contact the terminal on the front face of up of a probe card directly (namely, there is no agency of a mediation object) instead of a mediation object component.
[0025] Generally, with a spacing converter component, contact structure with two or more stability extended from the up front face becomes possible [connecting with the spacing converter (namely, contact structure which has stability as an adhesion pad or an alternative) in the lower front face in a comparatively coarse pitch] at the same time it contacts the terminal (namely, adhesion pad of a semiconductor device) of an electronic component in a comparatively detailed pitch (spacing).
[0026] According to one mode of this invention, the spacing transducer and mediation object component of a probe card assembly are prepared as a "kit" which suited using it with a probe card. It is also possible to include the device for adjusting the orientation of a spacing converter in a kit as arbitration.
[0027] According to one mode of this invention, the contact structure (probe element) with the stability extended from the up front face of a spacing transducer component is a "compound interconnect element" (specified below). In an alternative of contact structure with the stability extended from the lower front face of a spacing converter, these can be similarly made into a "compound interconnect element."
[0028] According to one mode of this invention, the contact structure with stability extended from the up front face and lower front face of a mediation object component is a "compound interconnect element" (specified below).

[0029] According to one mode of this invention, a probe element (contact structure with stability extended from the up front face of a spacing transducer component) is suitably formed as a "compound interconnect element" manufactured directly on the terminal of the spacing transducer component of a probe card assembly. In order that a "compound" (multilayer) interconnect element may mount an expanding element ("core") in an electronic component, it may fabricate so that it may have a spring configuration, it may strengthen the physical (for example, spring) property of the compound interconnect element as a result and/or may conclude the compound interconnect element as a result certainly in an electronic component, it is manufactured by performing protective coat generation to a core. The contact structure with the stability of a mediation object component can also be formed as a compound interconnect element again.
[0030] Use of the vocabulary "compound" should not be confuse with any use of the vocabulary "compound" in other fields of an attempt which be perform to ingredients, such as other fiber which be in agreement with terminological (for example, form from two or more elements) 'generic' semantics, for example, be support by the base material of glass, carbon or resin, and others, through the explanation indicated on these specifications.
[0031] The vocabulary the "spring configuration" used on these specifications says the configuration of the de facto arbitration of an expanding element of showing elastic (restoration) movement of the edge (tip) of an expanding element, to the force applied at a tip. A straight expanding element is also substantially contained in this in addition to the expanding element fabricated so that it might have one or more bends.
[0032] The "surface of action", the "terminal" and the "pad" which are used on these specifications, and the similar vocabulary say the electric conduction field of the arbitration on the electronic component of arbitration with which an interconnect element makes mounting or contact.
[0033] As an alternative, a core is cast, before mounting in an electronic component.
[0034] or [that a core is mounted as an alternative in some sacrifice substrates which are not electronic components] -- or they are some sacrifice substrates. A sacrifice substrate is removed in after shaping and protective coat generation before, or one of the back. According to one mode of this invention, the tip which has various kinds of structural descriptions can be arranged in the contact edge of an interconnect element. (Please refer to drawing 11 A-11F of the parent example mentioned above.) In the case of one example of this invention, a core is "elasticity" ingredient which has comparatively low yield strength, and protective coat generation is carried out with the "hard" ingredient which has comparatively high yield strength. For example, elasticity ingredients, such as a golden wire, are attached in the adhesion pad of a semiconductor device (for example, wirebonding), and protective coat generation is carried out with hard material, such as nickel and its alloy, (for example, electrochemistry plating).
[0035] The protective coat extended to some of overall lengths of the field opposite protective coat of a core, a single and a multilayer protective coat, the "coarse" protective coat (also refer to drawing 5 C and 5D of a parent example) that has a detailed lobe, and a core, or core length is indicated. In the case of the latter, the tip of a core is appropriately exposed, in order to make an electronic component contact (please also refer to drawing 5 B of a parent example).
[0036] Generally, the vocabulary "plating" is used for a core as an example of much techniques for generating a protective coat through the explanation indicated on these specifications. The various processes accompanied by deposition of the ingredient from a water solution although limitation is not within the limits of this invention, By the suitable technique of electrolytic plating, electroless deposition, a chemical-vapor-deposition method (CVD), physical vapor growth (PVD), the process that lets the induction disintegration of a liquid or the quality of the solid-state antecedent pass, and produces and cheats out of deposition of an ingredient, and the arbitration containing others Generally all these techniques for being able to carry out protective coat generation and depositing an ingredient on a core are the places of common knowledge.
[0037] Generally, in order to carry out protective coat generation with metallicity ingredients, such as nickel, an electrochemical process is suitable and especially electroless deposition is desirable.

[0038] In the case of other examples of this invention, a core is the expanding element of the "hard" ingredient which was essentially suitable for functioning as a spring element, and is mounted in the terminal of an electronic component in an end. Protective coat generation of the adjoining field is carried out at least with the ingredient of a core and a terminal which strengthens the conclusion to the terminal of a core. Thus, in advance of protective coat generation, a core does not necessarily need to be enough mounted in a terminal, uses the process which hardly does damage to an electronic component potentially, and the "temporary stop" of the core is carried out to a proper place to consecutive protective coat generation. Soldering of the edge of the hard core to the elasticity part of a terminal, attachment, and thrust **** are contained in a process [these / "it is easy"].
[0039] Suitably, a core takes the gestalt of a wire. As an alternative, a core is a flat tab (conductive metal ribbon).
[0040] A typical ingredient is indicated by both a core and the protective coat.
[0041] Henceforth, the technique accompanied by mainly starting with the comparatively elastic core (low yield strength) which is a general very small dimension (for example, 3.0 mils or less) is explained. Elasticity ingredients, such as gold which adheres to a semiconductor device easily, do not have stability sufficient generally to function as a spring. (This elastic metallicity ingredient shows the Lord instead of elastic deformation plasticity deformation.) Other elasticity ingredients which adhere to a semiconductor device easily and have suitable stability are non-conductive in many cases, and, in the case of most spring materials, this is so. In any case, structural [desired] and the desired protective coat to which electrical characteristics are given over a core can give the compound interconnect element as a result. The compound interconnect element as a result can be manufactured very small, and can also present still more suitable contact force. Furthermore, the compound interconnect element which plurality requires can be arranged in a detailed pitch (for example, 10 mils), though they have quite bigger die length (for example, 100 mils) than the distance (the distance between adjoining interconnect elements is called a "pitch") over an adjoining compound interconnect element.
[0042] A compound interconnect element can sometimes be manufactured within the limits of this invention on a micro scale like the "micro spring" for a connector and sockets which has the cross-section dimension of extent for example, below 25 microns (micrometer). This capacity that the good interconnect of dependability which has the dimension measured not by the mill but by the micron can be manufactured copes with a developing demand which is called an existing interconnect technique and a future area array technique head-on.
[0043] The compound interconnect element of this invention presents outstanding electrical characteristics, and conductivity, soldering possibility, and low contact resistance are contained in this. the deviation of the interconnect element which answered the contact force applied in many cases -- as a result -- "-- it is useful to guaranteeing that wipe, become" contact and this makes good contact of dependability.
[0044] The interconnect element of this invention and the connection made have the advantage of an addition of this invention in a dismountable point easily. Although soldering which brings interconnect to the terminal of an electronic component is arbitrary, generally it is not desirable in a system level.
[0045] According to one mode of this invention, the approach for manufacturing the interconnect element which has the impedance controlled is indicated. Generally, in such techniques, an electric conduction core or the whole compound interconnect element is covered with dielectric materials (insulating layer) (for example, in electrophoresis), and carrying out protective coat generation follows on dielectric materials in the external layer of an electrical conducting material at them. By grounding an external electrical conducting material layer, the interconnect element as a result can be covered effectively and the impedance becomes controllable easily. (Please also refer to drawing 10 K of a parent example.) one voice of this invention -- if it depends like, an interconnect element can be beforehand manufactured for the installation after an electronic component. Various kinds of techniques for attaining this purpose are indicated by this specification. Although not specifically protected with this document, it is thought that it is [in / an elastomer] also comparatively clear as mounting to the substrate of two or more

interconnect elements of each or an alternative to manufacture the machine which treats the suspension of two or more interconnect elements of each on a support substrate.
[0046] I hear that the compound interconnect element of this invention differs from the interconnect element of the conventional technique which strengthened the electric conduction property, or was covered in order to strengthen the corrosion resistance dramatically, and please understand clearly has it.
[0047] It means specifically that the protective coat of this invention strengthens substantially conclusion of the interconnect element to the terminal of an electronic component, and/or gives a desired restoration property to the compound interconnect element as a result. Stress (contact force) is turned [absorbing stress and] to the part of the interconnect element meant specifically.
[0048] Moreover, I hear that this invention essentially for manufacturing spring structure offers a new technique, and please recognize has it. Generally, the structure of the spring as a result of operation is bending and not the product of shaping but the product of plating. A door is opened by this to use of various kinds of "easy" processes for attaching in an electronic component the extensive ingredient which establishes a spring configuration, and the "scaffold" of a core. A protective coat functions as "supramolecular structure" covering the "scaffold" of a core, and the both mean having those zeros in the field of civil engineering.
[0049] A probe element does not need the ingredient of additions, such as brazing and soldering or soldering, but the unique advantage of this invention is in the point which can carry out direct manufacture on the terminal of the substrate component of the spacing converter of a probe card assembly.
[0050] one voice of this invention -- any of the contact structure which has stability if it depends like -- although -- it is formed as at least two compound interconnect elements.
[0051] Other purposes of this invention, the description, and the advantage will become clear in view of the following detailed descriptions.
[0052]
[Embodiment of the Invention] Reference is made by the detail to the suitable example of this invention, and the example is shown in the accompanying drawing. Although this invention is explained in relation to these suitable examples, not meaning limiting the pneuma of this invention and the range to the example of these specification should understand.
[0053] This patent application aims at a probe card assembly, its component, and the method of using them. Although it becomes clear from the following detailed explanation, in order to bring about pressure connection to the terminal of an electronic component, it is essential to use contact structure with stability. Contact structure with stability is suitably carried out as a "compound interconnect element", it applies on May 26, 1995 and this is indicated by the United States patent application 08th / indication of No. 452,255 ("parent example") which is incorporated on these specifications as reference and which was mentioned above. This patent application summarizes some of techniques indicated by parent application in the publication of drawing 15 and drawing 6 -14.
[0054] When the mechanical property of the compound interconnect element as (1) result is established and (2) interconnect elements are mounted in one terminal of an electronic component, in order that the important mode of this invention may conclude an interconnect element certainly for the terminal A "compound" interconnect element begins with a core (mounted in the terminal of an electronic component), and is in the point which can be formed by subsequently generating a protective coat to a core with a suitable ingredient. Thus, it is fabricated easily to the configuration in which elastic deformation is possible, and an interconnect element (spring element) with stability can be manufactured by starting with the core of the elasticity ingredient easily attached even in the brittlest part of an electronic component. If a spring element is formed from hard material and an example is easily taken in the conventional technique which is not [that it is not clear and] intuitive possible [demonstration], the elasticity ingredient can form the fundus of a spring element. A this "compound" interconnect element is contact structure which generally has the stability of a suitable gestalt although used for the example of this invention.

[0055] Generally drawing 1 , and 2, 3 and 4 show various kinds of configurations for compound interconnect elements where this invention was followed.
[0056] Henceforth, the compound interconnect element which presents stability is mainly explained. However, I hear that a compound interconnect element without stability also goes within the limits of this invention, and please understand has it.
[0057] Furthermore, henceforth, the compound interconnect element by which protective coat generation is carried out with a hard (elasticity) ingredient and which has an elasticity (it is fabricated easily and is easy to fix according to user-friendly process to electronic component) core is mainly explained. However, a core can sometimes be used as hard material within the limits of this invention, and a protective coat mainly functions on an electronic component as concluding an interconnect element certainly.
[0058] In drawing 1 , the core 112 of "elasticity" ingredient (for example, ingredient which has yield strength fewer than 40,000psi), and the shell (protective coat) 114 of a "hard" ingredient (for example, ingredient which has bigger yield strength than 80,000psi) are contained in the electric interconnect element 110. A core 112 is an expanding element fabricated as a in general straight cantilever (configuration), and can be used as the wire which has the diameter of 0.0005 to 0.0030 inches (0.001 inches = 1 mil ** 25 microns (micrometer)). Shell 114 is crossed to the already fabricated core 112, and is given according to the suitable process of arbitration, such as a suitable plating process (for example, electrochemistry plating).
[0059] Drawing 1 shows the straight cantilever by which orientation was carried out at a certain include angle to the spring configuration considered to be the probably easiest configuration to the interconnect element of this invention, i.e., the force applied in the tip 110b, "F." when this force is applied with the terminal of the electronic component in which the interconnect element is carrying out pressure contact, according to the deviation (seeing by a diagram) to the lower part at a tip, clearly, as a result, a tip crosses a terminal and moves -- namely, -- "-- it wipes and becomes" movement. This thing [that wipe and good contact of dependability is made between an interconnect element and the contact terminal of an electronic component by contact] is guaranteed.
[0060] It is the favor of the "hard nature", and shell 114 gives desired stability to the interconnect element 110 whole by controlling the thickness (0.00025 to 0.00500 inches). Thus, interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 110a and 110b of the interconnect element 110. (In drawing 1 , reference number 110a shows the end of the interconnect element 110, and the actual edge which countered edge 110B is not shown.) In case the terminal of an electronic component is contacted, the interconnect element 110 will receive contact force (pressure) as shown by the arrow head written by "F."
[0061] Although an interconnect element (for example, 110) will answer the contact force applied and it will deviate, this deviation (stability) is partially determined by the thickness of a protective coat ingredient with the whole interconnect element configuration partially [yield strength / of a protective coat (as opposed to yield strength of core) ingredient / superior (it is big)].
[0062] Vocabulary called the "cantilever type" and the "cantilever" which are used on these specifications is mounted in an end (immobilization), and expanding structure (for example, core 112 with a protective coat) usually answers the force of acting on a longitudinal direction in general to the longitudinal direction shaft of an expanding element, and moves the other end freely. By use of these vocabulary, the restrictive semantics with specific or others which means transfer or a hint does not have anything.
[0063] In drawing 2 , the elasticity core 122 (it is equal to 112) and the hard shell 124 (it is equal to 114) are similarly contained in the electric interconnect element 120. In the case of this example, a core 122 is fabricated so that it may have two bends, therefore it is considered that it is the shape of serpentine. Like the example of drawing 1 , interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 120a and 120b of the interconnect element 120. (In drawing 2 , reference number 120a shows the end section of the interconnect element 120, and the actual edge which countered edge 120b is not

shown.) In case the terminal of an electronic component is contacted, the interconnect element 120 will receive contact force (pressure) as shown by the arrow head written by "F."
[0064] In drawing 3 , the elasticity core 132 (it is equal to 112) and the hard shell 134 (it is equal to 114) are similarly contained in the electric interconnect element 130. In the case of this example, a core 132 is fabricated so that it may have one bend, and it can be considered that it is a U character configuration. Like the example of drawing 1 , interconnect with the stability between electronic components (un-illustrating) can be brought about between two edges 130a and 130b of the interconnect element 130. (In drawing 3 , reference number 130a shows the end section of the interconnect element 130, and the actual edge which countered edge 130b is not shown.) In case the terminal of an electronic component is contacted, the interconnect element 130 can receive contact force (pressure) as shown by the arrow head written by "F." As an alternative, the interconnect element 130 can be used, and as shown by the arrow head written by "F'", it can also contact except the edge 130b.
[0065] Drawing 4 shows other examples of the warehouse connection element 140 with stability which has the elasticity core 142 and the hard shell 144. In the case of this example, the interconnect element 140 is essentially an easy cantilever type (it is equal to drawing 1), and curved tip 140b receives the contact force "F" which acts on a longitudinal direction to that longitudinal direction shaft.
[0066] Drawing 5 shows other examples of the interconnect element 150 with stability which has the elasticity core 152 and the hard shell 154. In the case of this example, the interconnect element 150 is a C typeface "-like" in general, and as it has the tip which curved slightly suitably and is shown by the arrow head written by "F", it is suitable for making pressure contact.
[0067] I hear that understand can form an elasticity core in the configuration which answers the force applied at the tip at the configuration in which the elastic deformation of arbitration is possible, and the existing stable interconnect element, and is made to deflect elastically easily if it puts in another way, and it has it. For example, a core can also be formed in an idiomatic coil configuration. However, a coil configuration originates in the bad influence of the overall length of an interconnect element, the inductance (in addition to this) relevant to it, and the inductance to the circuit which operates by the RF (rate) and is not desirable.
[0068] The ingredient of at least one layer of shell or multilayer shell (it explains below) has yield strength sharply higher than the ingredient of a core. Therefore, in case shell establishes the mechanical property (for example, elasticity) of the interconnect structure as a result, it makes the shadow of a core thin. At least 2:1 is suitable for the ratio of the yield strength of a shell pair core, and can also make it high to about 10:1 also including at least 3:1 and at least 5:1. Moreover, even if shell or multilayer shell has little clear one, the external layer should be made conductivity and its shell is remarkable in a wrap case in the edge of a core. (However, the example in which the edge of a core is exposed to a parent example is indicated, and a core must be conductivity in that case.) Only the thing done for protective coat generation with hard material from a scientific viewpoint at the spring operation (spring configuration) part of the compound interconnect element as a result is the need. Generally it is not essential to both two edges of this viewpoint to a core to carry out protective coat generation. However, as a practical question, it is desirable to the whole core to carry out protective coat generation. The advantage produced in an electronic component at the end of a conclusion (cling) **** core in the specific reason for carrying out protective coat generation and it is further discussed in a detail below.
[0069] Although it is not limitation, gold, aluminum, copper, and those alloys are contained in the ingredient suitable for a core (112, 122, 132, 142). Although these ingredients are usually alloyed with a small amount of ingredients of other in order to acquire a desired physical property, they are beryllium, cadmium, silicon, magnesium, and others. It is also possible to use the metal or alloys of an element of silver, palladium, platinum, and the platinum group, such as a metal. Lead, tin, an indium, a bismuth, cadmium, antimony, and the solder that consists of those alloys are usable.
[0070] Generally field opposite installation (it discusses in a detail further below) of the end of the core (wire) to the terminal of an electronic component is the wire of the ingredient (for example, gold) of the arbitration which is easy to carry out bonding (for bonding to be brought

about using temperature, a pressure, and/or ultrasonic energy), and this is suitable for carrying out this invention. It is also within the limits of this invention that the ingredient containing a nonmetal material of the arbitration which is easy to carry out protective coat generation (for example, plating) can use it for a core. Into the ingredient suitable for shell (114, 124, 134, 144) Although it is not limitation, nickel and its alloy, (It discusses below about each layer of multilayer shell like) Copper, cobalt, iron and those alloys, and gold (especially hard gold) and silver that present the current conveyance capacity for both to have stood high, and a good contact resistance property, The element of the platinum group, noble metals, half-noble metals and those alloys especially the elements of the platinum group and those alloys, a tungsten, and molybdenum are contained. When solder-like finishing is a request, tin, lead, a bismuth, indiums, and those alloys can also be used.

[0071] The technique chosen in order to give these covering material over various kinds of core materials indicated above changes according to the thing of a non-theory, and an application. Generally electrolytic plating and electroless deposition are suitable techniques. However, generally plating over a golden core is not intuitive. When plating the shell of nickel over a golden core (electroless deposition is carried out especially), in order to make plating initiation easy according to one mode of this invention, it is desirable to give the initiation layer of thin copper over a golden wire stem first.

[0072] An instantiation interconnect element as shown in drawing 15 has the core diameter of about 0.001 inches, and 0.001 inches shell thickness, therefore an interconnect element has about 0.003 inches diameter of the whole (namely, twice as many core diameter **** [as this] shell thickness). Generally, this thickness of shell becomes about 0.2 to 5.0 (from 1/5 to 5) twice the thickness (for example, diameter) of a core.

[0073] Some instantiation-parameters about a compound interconnect element are as follows.

[0074] (a) The wire core of the gold which has the diameter of 1.5 mils is fabricated so that it may have the abbreviation C character-like curve (it is equal to drawing 5) of the overall length of 40 mils, and a 9-mil radius, it is plated with 0.75-mil nickel (diameter =of the whole1.5+2x0.75=3 mil), and receives the 50-microinch golden last protective coat as ** and arbitration. The compound interconnect element as a result presents the spring constant (k) of about 3 - 5g/mil. At the time of use, a 3 to 5-mil deviation serves as 9 - 25g contact force as a result. This example is useful in relation to the spring element for insertion objects.

[0075] (b) The wire core of the gold which has the diameter of 1.0 mils is fabricated so that it may have the overall length of 35 mils, it is plated with 1.25-mil nickel (diameter =of the whole1.0+2x1.25=3.5 mil), and receives the 50-microinch golden last protective coat as ** and arbitration. The compound interconnect element as a result presents the spring constant (k) of about 3g/mil, and is useful in relation to the spring element for probes.
 [0076] (c) The wire core of the gold which has the diameter of 1.5 mils is fabricated so that it may have the letter curve with an overall length [of 20 mils], and a radius of about 5 mils of the abbreviation for S characters, and it is plated with 0.75-mil nickel or copper (diameter =of the whole1.5+2x0.75=3 mil). The compound interconnect element as a result is useful in relation to the spring element for showing the spring constant (k) of about 2 - 3g/mil, and mounting on a semiconductor device.

[0077] Below, as further shown in a detail, a core does not need to have a round cross section, and it can also consider as the flat tab (it has a rectangle cross section) rather extended from a sheet. The vocabulary the "tab" which uses "understand" on these specifications is not mixing up with "TAB" (tape automation bonding).

[0078] Multilayer shell drawing 6 shows one example 200 of the interconnect element 210 mounted in the electronic component 212 with which a terminal 214 is formed. In the case of this example, in an end, bonding is carried out to a terminal 214 (attached), the elasticity (for example, gold) wire core 216 is constituted so that it may extend from a terminal and may have a spring configuration (it is equal to the configuration shown in drawing 2), and it is cut so that it may have ** and free-end 216b. Thus, the bonding of a wire, shaping, and cutting are attained using wirebonding equipment. The adhesives in edge 216a of a core cover only the comparatively small part on the front face of exposure of a terminal 214.

[0079] Shell (protective coat) is arranged over the wire core 216, and in the case of this example, it is shown as multilayering, and has a inner layer 218 and an outer layer 220, and the layer of those both is appropriately given according to a plating process. One or more layers of multilayer shell are formed from hard material (nickel, its alloy, etc.), and desired stability is given to the interconnect element 210. for example, an outer layer 220 can be used as hard material, and in case a inner layer plates hard material 220 on core materials 216, it can use it as the ingredient which functions as a barrier layer and a binder layer or -- as a buffer or a barrier layer. As an alternative, a inner layer 218 can be used as hard material, and it can also consider as the ingredient which presents the outstanding electrical characteristics which include conductivity and soldering possibility for an outer layer 220 (elastic gold etc.). When contact of solder or brazing-and-soldering form is a request, the outer layer of an interconnect element can be made into the charge of a lead-tin solder or golden-tin wax tie, respectively.
[0080] Conclusion drawing 6 to a terminal shows in the gross that it can conclude for the terminal on an electronic component certainly [the other important descriptions of this invention, i.e., an interconnect element with stability,]. Attachment edge 210a of an interconnect element receives large mechanical stress as a result of the compressive force (arrow head "F") applied to free-end 210b of an interconnect element.
[0081] For a protective coat (218 220), the whole exposure front face of the remainder (namely, except adhesives 216a) of the terminal 214 which adjoins a core (have no interruption) 216 not only the core 216 but in succession [as shown in drawing 6] is also a wrap. The interconnect element 210 is concluded with dependability certainly and sufficient for a terminal by this, and a protective coat ingredient contributes substantially (for example, more greatly than 50%) to conclusion of the interconnect element as a result of a terminal by it. Generally, the thing which is the need is only that a protective coat ingredient covers some terminals [at least] which adjoin a core. However, as for a protective coat ingredient, generally, it is desirable to cover the whole remaining front face of a terminal. Suitably, each class of shell is metallicity.
[0082] As a general proposal, the comparatively small field where a core is attached in a terminal (adhesion) is seldom suitable for absorbing the stress produced from the contact force ("F") imposed on the compound interconnect element as a result. Shell is concluded certainly [the whole interconnect structure] for a terminal by wrap favor in the whole (except for the comparatively small field in which core edge 216a to a terminal is attached) exposure front face of a terminal. The bond strength of a protective coat and the capacity to react to contact force are farther [than that of the core edge (216a) itself] high.
[0083] Although it is not limitation, interconnect and an insertion substrate, the suitable semiconductor wafer made from a semiconductor material and suitable die of arbitration, such as silicon (Si) or gallium arsenide (GaAs), a generation interconnect socket, a trial socket, a sacrifice member, an element and a substrate that are indicated by the parent example, a ceramic, a plastic package and the semiconductor package containing a chip carrier, and a connector are contained in the vocabulary the "electronic component" (for example, 212) used on these specifications.
[0084] The interconnect element of this invention is suitable for using as the following especially enough. That is, they are the interconnect element which does not need to have - semiconductor package and is directly mounted in a silicon die, the interconnect element extended as a probe from a substrate (it explains to a detail further below) in order to examine - electronic component, and the interconnect element of - insertion object (it discusses in a detail further below).
[0085] The interconnect element of this invention does not look at a kind in that the benefit of the mechanical property (for example, high yield strength) of hard material is received, without restricting it with the usually poor bonding property of accompanying of hard material. This becomes greatly possible according to the fact that shell (protective coat) functions as "supramolecular structure" over the "scaffold" of a core as stated to the parent example in detail. Here, these two vocabulary is borrowed from the environment of civil engineering. Generally it differs very much from the impossible plating-ized interconnect element of the conventional technique that plating is used as protection (for example, corrosion-proof) covering,

and this gives a desired mechanical property to interconnect structure. moreover, nonmetallic corrosion-proof covering of arbitration of the benzotriazol (BTA) given to the interconnect section with this electric — a certain kind — it is remarkably contrastive.
[0086] In many advantages of this invention, since two or more independence interconnect structures are easily formed on a substrate to the common height on a substrate from the different level, such as PCB which has a decoupling capacitor, those free end has an advantage of coplanar ****** mutually. Furthermore, it doubles easily electrically [the interconnect element formed according to this invention] to the application of specification [both mechanical (for example, plastic and elasticity) properties]. For example, in a given application, it is desirable that an interconnect element presents plastic and elastic deformation. (The thing with desirable plastic deformation is for absorbing the total non-plane nature in the component which interconnects with an interconnect element.) When elastic behavior is a request, it is required for an interconnect element to generate the contact force of the minimum threshold dose, and to bring about good contact of dependability. Moreover, an advantage originates in the contamination film existing accidentally on a contact front face, and the tip of an interconnect element has it also in the point of wiping with the terminal of an electronic component and contacting.
[0087] The vocabulary which uses on these specifications and is applied to contact structure "there is stability" answers the added load (contact force), and the contact structure (interconnect element) which presents mainly elastic behavior is meant, and the vocabulary of "being obedient" answers the added load (contact force), and the contact structure (interconnect element) which presents both elastic and plastic behavior is meant. "Obedient" contact structure which is used on these specifications is contact structure "with stability." The compound interconnect element of this invention is obedient, or is one special case of the contact structures with stability.
[0088] The step which manufactures an interconnect element on a sacrifice substrate although many descriptions are stated to the parent example at the detail and it is not limitation, In order to make the step which carries out the package imprint of two or more interconnect elements, the step which establishes the contact tip which is coarse surface finish suitably in an interconnect element, and connection temporary and eternal subsequently in an electronic component at an electronic component The step which uses an interconnect element on an electronic component, and the step arranged so that it may have spacing in an end which is different from spacing in those opposite edges in an interconnect element, So that the difference by the thermal expansion between the components connected with the step which manufactures an interconnect element, and the step which manufactures a spring clip and an alignment pin at the step of the same process may be absorbed The step which uses an interconnect element, the step which abolishes the need for the semiconductor packages (SIMM etc.) according to individual, and the step which solders an interconnect element (contact structure with stability) with stability as arbitration are included.
[0089] Controlled impedance drawing 7 shows the compound interconnect element 220 which has a multilayer. the innermost section (internal long and slender electric conduction element) 222 of the interconnect element 220 described above — as — a non-covered core — or it is either of the cores by which protective coat generation has already been carried out. The mask of the tip 222b of the innermost section 222 is carried out with a suitable masking material (un-illustrating). A dielectric layer 224 is given over the innermost section 222 according to an electrophoretic process etc. The outer layer 226 of an electrical conducting material is given over a dielectric layer 224.
[0090] An interconnect element will have the controlled impedance as a result by grounding an outer layer 226 electrically at the time of use. The instantiation-ingredients for dielectric layers 224 are polymeric materials, and it is the suitable method of arbitration and they are given to the suitable thickness (for example, 0.1 to 3.0 mils) of arbitration.
[0091] An outer layer 226 can be made into a multilayer. For example, in the example whose innermost section 222 is a non-covered core, when it is a request that the whole interconnect element presents stability, at least one layer is a spring material among outer layers 226.

[0092] Pitch modification drawing 8 shows the example 250 in which the interconnect element 251—256 of plurality (illustration many inside six pieces) is mounted on the front face of the electronic components 260, such as probe card insertion (subassembly mounted in a probe card by the idiomatic method). The terminal of probe card insertion and electric conduction trace are omitted from this drawing for clear-izing of illustration. The attachment edge of the interconnect element 251—256 starts in the 1st pitch (spacing) of 0.05 - 0.10 inches. the interconnect element 251—256 serves as the 2nd detailed pitch of 0.005 - 0.010 inches in those free end (tip) — as — shaping — and/or, orientation is carried out. The interconnect assembly which interconnects from a certain pitch to another pitch is usually called a "spacing converter."
[0093] Like illustration, it is tip 251b of an interconnect element. — Although 256b is arranged by seriate [two / parallel], this is for making the semiconductor device which has two parallel trains of for example, an adhesion pad (contact) contact (at the time of a trial and/or aging). Although an interconnect element can be arranged so that it may have other tip putters, this is for making the electronic component which has other contact patterns, such as an array, contact.
[0094] Although only one interconnect element is generally shown through the example indicated by this specification, this invention can manufacture two or more interconnect elements, and can apply them also to the thing [say / a circumference pattern or a rectangle array pattern] for which two or more interconnect elements of each other by regular space relation are arranged.
[0095] Mounting of the direct interconnect element to the terminal of the use electronic component of a sacrifice substrate was explained above. Speaking in the gross, manufacture or mounting on the suitable front face of the arbitration of the suitable substrate of the arbitration containing a sacrifice substrate being possible for the interconnect element of this invention.
[0096] Although it observes a parent example, to this, as separate and unique structure for mounting of the consecutiveness for example, to an electronic component The publication about drawing 11 A-11F which manufacture two or more interconnect structures (for example, contact structure with stability), And two or more interconnect elements are mounted in a sacrifice substrate (carrier), and there is a publication about drawing 12 A-12C which, subsequently to an electronic component, imprints two or more interconnect elements in a bundle.
[0097] Drawing 9 -11 shows the technique for manufacturing two or more interconnect elements which carried out tip structure using a sacrifice substrate.
[0098] Drawing 9 shows the 1st step of technique 250, and the patternizing layer of a masking material 252 is given on the front face of the sacrifice substrate 254. Being able to use the sacrifice substrate 254 as thin (1 to 10 mils) copper or aluminium foil as an example, a masking material 252 serves as a common photoresist. In the locations 256a, 256b, and 256c which ask for manufacture of an interconnect element, the masking layer 252 is patternized so that it may have opening of plurality (illustration many inside three pieces). Locations 256a, 256b, and 256c are this semantics, and are equal to the terminal of an electronic component. Locations 256a, 256b, and 256c are suitably processed in this phase, and have a coarse or characteristic surface pattern. Like illustration, this is mechanically attained in locations 256a, 256b, and 256c by the mold push fixture 257 which forms a hollow in a foil 254. It is also possible to etch the front face of the foil in three locations chemically as an alternative, so that it may have a surface pattern. The technique of the arbitration suitable for bringing about this general purpose is within the limits of this invention, for example, are sand blasting, a peening, and others.
[0099] Next, the conductive tip structure 258 of plurality (illustration many inside one) is formed in each location (for example, 256b) as shown in drawing 10. This is attained using a suitable technique of arbitration, such as electrolytic plating, and includes the tip structure of having a multilayer ingredient. for example, the thin (for example, 10 - 100 microinches) barrier layer of the nickel with which tip structure 258 is given on a sacrifice substrate — elastic gold is continuously thin (for example, 10 microinches) — continuing — the thin (for example, 20 microinches) layer of hard gold — it has the comparatively thick (for example, 200 microinches) layer of nickel, and the thin (for example, 100 microinches) last layer of elastic gold continuously. Generally, the 1st thin barrier layer of nickel is prepared, in order that the layer of consecutive gold may prevent "decomposing" with the ingredient (for example, aluminum, copper) of a

substrate 254, the comparatively thick layer of nickel is for giving reinforcement to tip structure, and the last film of elastic gold gives the front face pasted up easily. This invention is not limited to any specific examples of the approach of forming tip structure on a sacrifice substrate. Because, these specific examples are for changing inevitably according to an application.
[0100] it is shown in drawing 10 -- as -- the core 260 of the plurality for interconnect elements (illustration many inside one) -- for example, it is formed on the tip structure 258 of either of the techniques which carry out bonding of the elastic wire core to the terminal of the above-mentioned electronic component. Next, protective coat generation is suitably carried out with hard material 262 by the above-mentioned method, subsequently a masking material 252 is removed, and as a result, a core 260 serves as the independence interconnect element 264 of plurality (illustration many inside three) mounted in the front face of a sacrifice substrate, as shown in drawing 11.
[0101] The protective coat ingredient 262 as well as a wrap protective coat ingredient concludes a core 260 for the field which was explained in relation to drawing 6 and where the terminal (214) adjoined at least certainly in those tip structures 258 of corresponding, and, in a request, a restoration property is given to the interconnect element 262 as a result. As annotated with the parent example, the package imprint of two or more interconnect elements mounted in a sacrifice substrate is carried out at the terminal of an electronic component. Two paths which branched extensively can also be taken as an alternative.
[0102] It is also within the limits of this invention that being able to use a silicon wafer as a sacrifice substrate and tip structure's being manufactured on it and the tip structure manufactured such can connect with contact structure with the stability already mounted in the electronic component (for example, soldering, brazing and soldering).
[0103] As shown in drawing 12, the sacrifice substrate 254 is simply removed by the suitable process of arbitration, such as selectivity chemical etching. Since almost all selectivity chemical etching etches one ingredient by the quite bigger ratio than the ingredient of another side and small deer etching of the ingredient of another side is not carried out at that process, the thin barrier layer of the nickel in tip structure is removed by removal and coincidence of a sacrifice substrate, using this phenomenon advantageously. However, if required, a thin nickel barrier layer is removable also at a consecutive etching step. As a result, it is dispersed to each of plurality (illustration many inside three), and becomes the unique interconnect element 264, and this is shown by the dotted line 266 by this, and the terminal on an electronic component is equipped later (soldering or brazing and soldering).
[0104] moreover -- reference should be made -- a protective coat ingredient is the process which removes a sacrifice substrate and/or a thin barrier layer, and is the point of being slightly made thin. However, it is more desirable for this not to arise.
[0105] In order to prevent thin smallness-ization of a protective coat, it is desirable that about 10-microinch elastic gold given over a golden film or about 20-microinch hard gold is given as the last layer over the protective coat ingredient 262. Generally the outer layer of this gold has high impermeability to almost all the etching solution that means the outstanding conductivity, contact resistance, and soldering possibility, and mainly meant using for removal of a barrier layer and a sacrifice substrate.
[0106] As an alternative, as shown in drawing 13, it precedes with removal of the sacrifice substrate 254, and the suitable supporting structure 266 of arbitration, such as a thin plate with which the interconnect element 264 of plurality (illustration many inside three) has two or more holes inside, "is fixed" due to a mutual space request, and a sacrifice substrate is removed based on it. The supporting structure 266 can be used as the electrical conducting material by which protective coat generation is carried out with dielectric materials or dielectric materials. Further processing step called the step which equips electronic components, such as a silicon wafer or a printed circuit board, with two or more interconnect elements advances next. In addition, in some applications, it is desirable to stabilize so that the tip (tip structure was countered) of the interconnect element 264 may not move, and especially this is the case where contact force is applied there. It is the suitable sheet 268 which has two or more holes [say / the mesh in which desirable one was formed from dielectric materials] since it is this purpose,

and is giving constraint to migration of the tip of an interconnect element.
[0107] Tip structure (258) is formed from the ingredient of a request of arbitration as a matter of fact, and the unique advantage of the above-mentioned technique 250 is in the point of having the pattern of a request of arbitration as a matter of fact. As mentioned above, gold is an example of noble metals which presents the electrical characteristics of conductivity, low contact resistance, soldering possibility, and corrosion resistance which stood high. Since gold is forgeability again, it is suitable for considering as the last protective coat given over either an interconnect element given in this specification, especially an interconnect element with stability given in this specification enough [very]. Other noble metals present a desirable property similarly. However, generally some ingredients which present these electrical characteristics that stood high, such as a rhodium, are not suitable to carry out protective coat generation at the whole interconnect element. For example, a rhodium is remarkably weak and does not fully function as the last protective coat on an interconnect element with stability. The technique represented by technique 250 conquers this limit easily about this. For example, the 1st layer of multilayer tip structure (see 258) can be made into a rhodium (not being gold as mentioned above), and thereby, in order to contact it in an electronic component, without having effect of what on any mechanical behavior of the interconnect element as a result, it pulls out the outstanding electrical characteristics.
[0108] Drawing 14 shows the alternative example 270 for manufacturing an interconnect element. In the case of this example, a masking material 272 is given to the front face of the sacrifice substrate 274, and like the technique described above about drawing 9 , it is patternized so that it may have the opening 276 of plurality (illustration many inside one). Opening 276 specifies the field by which an interconnect element is manufactured as a free standing structure. (That the interconnect element used for this specification through explanation of a publication is "independence") it is the case where bonding of the end is carried out to a field with the terminal of an electronic component, or a sacrifice substrate, and bonding of the other end is not carried out to an electronic component or a sacrifice substrate. As shown 278 by the single hollow extended in the front face of the sacrifice substrate 274, encaustic processing of the field in opening is carried out by the suitable method of arbitration so that it may have one or more hollows.
[0109] Bonding of the core (wire stem) 280 is carried out to the front face of the sacrifice substrate in opening 276, and it has the suitable configuration of arbitration. In this illustration, only the end of one interconnect element is shown for clear-izing of instantiation. The other end (un-illustrating) is attached in an electronic component. In that direct bonding of the core 280 is carried out to the sacrifice substrate 274 instead of the tip structure 258, I hear that seeing easily here differ in the technique 250 which technique 270 mentioned above, and there is. As an example, bonding of the golden wire core (280) is easily carried out to the front face of an aluminum substrate (274) using an idiomatic wirebonding technique.
[0110] At the next step of a process (270), it is given on the exposed region of the substrate 274 in opening 276 with which the golden layer 282 covers a core 280, and includes the inside of a hollow 278 (for example, plating). the main purposes of this layer 282 are forming a contact front face in the edge of the interconnect element as a result, when a sacrifice substrate is removed namely,.
[0111] Next, the layer 284 of comparatively hard ingredients, such as nickel, is given over a layer 282. As mentioned above, one main purpose of this layer 284 is giving a desired mechanical property (for example, stability) to the compound interconnect element as a result. In this example, other main purposes of a layer 284 are strengthening the endurance on the front face of contact manufactured by the edge (it is illustration like) with the lower interconnect element as a result. Although the golden last layer (un-illustrating) will be given over a layer 284, this is for strengthening the electrical characteristics of the interconnect element as a result.
[0112] an interconnect element with plurality in the last step, a masking material 272 and the sacrifice substrate 274 are removed, and unique as a result (it is equal to drawing 12) -- or it becomes either of two or more interconnect elements (it is equal to drawing 13) which has predetermined space relation mutually.

[0113] This example 270 is a typical technique for manufacturing the contact tip of encaustic processing at the edge of an interconnect element. In this case, an example in which the "golden overlay of nickel" contact tip excelled was explained. However, it is also within the limits of this invention for other similar contact tips to be able to manufacture at the edge of an interconnect element according to the technique of a publication to these specifications. A contact tip has another description of this example 270 in the point constituted by not the inside of the front face of a sacrifice substrate (254) which was meant in the former example 250 but the whole crowning of a sacrifice substrate (274).
[0114] Generally the technique of the introduction above of a mediation object explains a new technique for manufacturing a compound interconnect element, and the physical characteristic is easily doubled so that the stability of a desired degree may be shown.
[0115] Generally, the compound interconnect element of this invention is easily mounted in the substrate which functions as a mediation object (manufacture), a mediation object is arranged between two electronic components, they are interconnected and one of two electronic components is arranged in each ** of a mediation object. The manufacture and use of a congestion interconnect element in a mediation object are indicated by the United States patent copending application 08th by these above-mentioned people / No. 526,426 at the detail.
[0116] Generally the above-mentioned technique explains a new technique for manufacturing a compound interconnect element, the physical characteristic is easily doubled so that the stability of a desired degree may be shown, and generally the above-mentioned technique explains the capacity to manufacture a mediation object, using this compound interconnect element.
[0117] Generally, the compound interconnect element of this invention is easily mounted in a substrate, as the tip of an interconnect element is arranged that the field (for example, adhesion pad) where the semiconductor device was chosen should be contacted (manufacture).
[0118] The parent example is indicating the various techniques for applying a probe to a semiconductor device.
[0119] In the mediation object, the meaning using the interconnect element of this invention was expressed above. Generally, the "mediation object" used for this specification is a substrate, it has contact on the two front faces which countered, it is arranged between two electronic components, and the two electronic components are interconnected. Occasionally, it is desirable for a mediation object to make possible at least one of two interconnect elements (to for example, exchange, updating, and others sake).
[0120] Mediation object example #1 drawing 15 shows one example 300 of the mediation object which used the interconnect element of this invention. Generally, in the insulating substrates 302, such as a substrate of PCB form, the conductive through hole (for example, plated Bahia) 306 of plurality (illustration many inside two), and 308 and others are prepared, and the each has in them the conductive part exposed in up (above) surface 302a of an insulating substrate 302, and lower (below) surface 302b.
[0121] One pair of elasticity cores 311 and 312 are attached in the exposed part of a through hole 306 in up surface 302a of a substrate 302. One pair of elasticity cores 313 and 314 are attached in the exposed part of a through hole 306 in the lower front face of a substrate 302. Similarly, one pair of elasticity cores 315 and 316 are attached in the exposed part of a through hole 308 in the up front face of a substrate 302, and one pair of elasticity cores 317 and 318 are attached in the exposed part of a through hole 308 in the lower front face of a substrate 302. Next, protective coat generation of the core 311-318 is carried out with hard material 302, and the interconnect structures 322 and 324 are formed in up surface 302a of a substrate 302, and the interconnect structures 326 and 328 are formed in lower surface 302b of a substrate 302. Thus, each core 311-318 is certainly concluded by the exposed part to which a through hole corresponds, and the interconnect structure 322 is electrically connected to the interconnect structure 326, and the interconnect structure 324 is electrically connected to the interconnect structure 328. when understand here establishes each interconnect structure (for example, 322) as one pair of interconnect elements (311 for example, 312), connection with still more sufficient dependability with an external component (un-illustrating) brings -- having (namely, a single interconnect element -- using -- also depending) -- it is saying.

[0122] Like illustration, all of the up group of the interconnect elements 311, 312, 315, and 316 are formed in the same configuration, and all the lower groups of an interconnect element also have the same configuration. Please understand can prepare the lower group of an interconnect element a different configuration from the up group of an interconnect element, and, thereby, the interconnect structure extended from the lower front face of a substrate is that an opportunity to make the interconnect structure extended from the up front face of an insulating substrate of having a different mechanical property is given.
[0123] Mediation object example #2 drawing 16 shows other examples 330 of the mediation object which used the interconnect element of this invention. In the case of this example, the interconnect element 332 of plurality (illustration many inside one) is manufactured by the pattern (for example, array) of a request on a sacrifice substrate (un-illustrating). Two or more holes 336 are similarly established in the support substrate 334 by the corresponding pattern. The support substrate 334 is arranged over the interconnect element 332 so that the interconnect element 332 may extend through a hole 336. With the suitable ingredients 338 (elastomer etc.) filled up with a hole 336, an interconnect element is loosely held within a support substrate, and is extended from both the upper part of a support substrate, and a lower front face. Next, a sacrifice substrate is removed. Although it is clear, the support substrate 334 (it is equal to 266) "can be dropped" simply in the process which manufactures this mediation object assembly on two or more interconnect elements (it is equal to 264) mounted in a sacrifice substrate (254).
[0124] Mediation object example #3 drawing 17 shows other examples 360 of the mediation object which used the interconnect element of this invention. Although this example 360 is similar to the example 330 explained above, it removes the point that the interconnect structure 362 (it is equal to 332) is supported by soldering the pars intermedia of the interconnect structure 362 to the plating section 368 on the through hole 366 of a support substrate in the hole 366 (it being equal to 336) of the support substrate 364 (it is equal to 334). Too, the support substrate 364 (it is equal to 266) "can be dropped" simply in the process which manufactures this mediation object assembly on two or more interconnect elements (it is equal to 264) mounted in a sacrifice substrate (254).
[0125] Drawing 16 and 17 are instantiation of the fact that single connection of the terminal with which two electronic components correspond can be brought about using a single interconnect element (332 362). It is also understood here instead of the interconnect element of this invention as shown in drawing 16 and 17 that the electric conduction element of arbitration can be used, and it is within the limits of this invention.
[0126] In drawing 15 and the mediation object example of 16 and 17, that an electronic component (un-illustrating) is arranged in the both sides of a mediation object (300, 330, 360) in order that a mediation object may make electrical installation between the terminal (un-illustrating) should understand.
[0127] Explanation of the interconnect element from a sheet of the formation above mainly narrowed down the target from the elasticity wire core and the wire core whose hard protective coat is an example of representation and by which shaping and protective coat generation were carried out to the approach of forming a compound interconnect element in general. This invention is applicable also to the method of forming the interconnect element formed from the metal sheet with which it is patternized in order to form a metal sheet and the flat expanding element (tab) by which is an elasticity metal sheet suitably, and is fabricated and protective coat generation is suitably carried out with hard material (****** or etching) again. These contents are explained by the above-mentioned United States patent application 08th / No. 526,246 in full detail.
[0128] drawing 15 -17 explained **** on the spacing converter is applicable to this invention — it is (suitable) — the technique for manufacturing a mediation object and them is indicated. Although the compound interconnect element of this invention was explained, it should mainly understand clearly that the interconnect element (spring) which has the stability of arbitration including the spring structure manufactured from the monolithic ingredient essentially manufactured with elasticity from phosphor bronze and beryllium copper is usable.

[0129] "Spacing conversion" (occasionally called "a pitch escape") is an important concept applicable to this invention. If it says simply, what the tip of contact structure with stability approaches more nearly mutually than connection with those fundi, and spacing can be opened for (comparatively detailed pitch) is important. As shown in drawing 8 explained above, this can be attained by giving the inclination to have the die length from which molding and the contact structure which carries out orientation, and is completed mutually, consequently has each stability differ each spring element (251-256). Generally, in relation to a probe card assembly, all the probe elements (contact structure with stability) have the same die length mutually, and it is very important that fixed nature is guaranteed in two or more signal paths needed.
[0130] Drawing 18 shows the typical design of the spacing converter 400 according to this invention, and desired spacing conversion is attained by not molding of contact structure (un-illustrating) with each stability attached but the substrate 402 of a spacing converter.
[0131] The spacing converter substrate 402 is suitably formed as a multilayer component which has up (seeing by a diagram) surface 402a and lower (seeing by a diagram) surface 402b, and has the intersection alternation of strata of an insulating material (for example, ceramic) and an electrical conducting material. In the case of this example, one wiring layer is illustrated so that the two electric conduction (many inside) traces 404a and 404b may be included.
[0132] The terminals 406a and 406b of plurality (illustration many inside two) are arranged in up surface 402a of the spacing (approaching comparatively mutually) converter substrate 402 in a comparatively detailed pitch. The terminals 408a and 408b of plurality (illustration many inside two) are arranged in lower surface 402b of the spacing (separating from each other further to Terminalsa [406] and 406b) converter substrate 402 in a comparatively coarse pitch. For example, the lower terminals 408a and 408b are arranged in the pitch (it is equal to constraint of a printed circuit board) of 50 to 100 mils, can arrange the up terminals 406a and 406b in the pitch (it is equal to center-to-center spacing of the adhesion pad of a semi-conductor die) of 5 to 10 mils, and serve as 10:1 pitch conversion as a result. The up terminals 406a and 406b are connected to the lower terminals 408a and 408b which connect a terminal to the electric conduction traces 404a and 404b and which correspond, respectively by the conductors 410a/412a related, respectively and 410b/412b, respectively. Generally this is common knowledge altogether in relation to a multilayer land grid array (LGA) support substrate and others.
[0133] Probe card assembly drawing 19 shows one example of the probe card assembly 500, and this is suitable for making temporary interconnect to a semiconductor wafer 508 as the main functional component including the probe card 502, the mediation object 504, and the spacing converter 506. In the sectional view of this disassembly and assembly, some elements of some components are exaggerated and shown for clear-izing of instantiation. However, the alignment of the perpendicular direction (it is illustration like) of various kinds of components is appropriately shown by the dotted line of a drawing. Please mind is a point by which the interconnect element (514, 516, 524, and these are further explained to a detail below) is shown partially and completely.
[0134] Generally, a probe card 502 is the idiomatic circuit board, and has the surface of action (terminal) 510 of plurality (illustration many inside two) arranged in the up (seeing by a diagram) front face. The further component (un-illustrating), for example, activity, and a passive electronic component, a connector, and others can also be mounted in a probe card. The terminal 510 on the circuit board is usually arranged in the pitch (a pitch is specified above) of 100 mils. A probe card 502 is appropriately roundish and has the diameter of about 12 inches.
[0135] A substrate 512 (it is equal to a substrate 302) is contained in the mediation object 504. The interconnect element 514 which has the stability of plurality (illustration many inside two) as mentioned above It is mounted in the lower (seeing by a diagram) front face of a substrate 512 (those juxtaposition edges). **, The interconnect element 516 which extends in a lower part (seeing by a diagram) from there, and has the corresponding stability of plurality (illustration many inside two) is mounted in the up (seeing by a diagram) front face of a substrate 512 (those juxtaposition edges), and extends from ** and there to the upper part (seeing by a diagram). any of an above-mentioned spring configuration — although — it is suitable for the interconnect

elements 514 and 516 with stability which are compound interconnect elements of this invention suitably. As a general proposal, among the interconnect elements 514 and 516, the tip (distal end) of both the bottom plurality 514 and the top plurality 516 is a pitch which is in agreement with the pitch of the terminal 510 of a probe card 502, for example, is 100 mils.
[0136] The interconnect elements 514 and 516 are shown by the exaggeration scale for clear-izing of instantiation. Typically, the interconnect elements 514 and 516 will be extended even from the lower part and the up front face where the mediation object substrate 512 corresponds to 20 to 100-mil whole length. Generally, the height of an interconnect element is decided from the magnitude of desired compliance.
[0137] The substrate 518 (it is equal to above 402) circuit-ized appropriately is contained in the spacing converter 506. This for example It is a multilayered ceramic substrate and has the terminal (a surface of action, pad) 520 of plurality (illustration many inside two) arranged in the bottom (seeing by a diagram) front face, and the terminal (a surface of action, pad) 522 of plurality (illustration many inside two) arranged in the top (seeing by a diagram) front face. In the case of this example, two or more lower contact pads 520 are arranged in the pitch (for example, 100 mils) at the tip of the interconnect element 516, and two or more upper contact pads 522 are arranged in a more detailed (it approached) pitch (for example, 50 mils). Although the interconnect elements 514 and 516 with these stability are suitable, they do not necessarily need to be compound interconnect elements (it is equal to above 210) of this invention.
[0138] the interconnect element 524 (a "probe" --) with the stability of plurality (illustration many inside two) A "probe element" is direct () to a terminal (contact pad) 522. Namely, the wire which connects a probe element to a terminal does not have the vector which consists of an additional ingredient. or a terminal -- a probe element -- brazing and soldering -- it is mounted, without soldering (those juxtaposition edges), and extends to the upper part (seeing by a diagram) from the up (seeing by a diagram) front face of the spacing converter substrate 518. Like illustration, those tips (distal end) can open spacing in a pitch (for example, 10 mils) still more detailed than those juxtaposition edges, and thereby, the interconnect element 524 with these stability is appropriately arranged so that pitch reduction of the spacing transducer 506 may be reinforced. Although the contact structure (interconnect element) 524 with these stability is suitable, it does not necessarily need to be the compound interconnect element (it is equal to above 210) of this invention.
[0139] a probe element (524) is manufactured on a sacrifice substrate (it is equal to drawing 9 - 11), and mounts in the terminal (522) of a spacing converter component (506) separately continuously -- having (it being equal to drawing 12) -- or it is within the limits of this invention for what is done for a package move (it is equal to drawing 13) to be also possible for these terminals.
[0140] As everyone knows, phot lithography, deposition, diffusion, and two or more other die sites formed more are included in a semiconductor wafer 508 on the anterior part (it sees by a diagram and is the bottom) front face. Typically, similarly these die sites are manufactured mutually. However, some die sites may serve as a malfunction in accordance with the fully established trial criteria as a result as everyone knows according to one of the defects in either of the processes which the defect of the wafer itself or a wafer wears to formation of a die site. Before simplifying a semi-conductor die from a semiconductor wafer, it originates in attendant difficulty applying a probe to a die site, and a trial process is often carried out, after simplifying and mounting a semi-conductor die. When a defect is discovered after mounting of a semi-conductor die, net loss gets worse by the costs which accompany mounting of a semi-conductor die. Although a semiconductor wafer has the diameter of at least 6 inches, it is usually included no less than at least 8 inches.
[0141] Each die site usually has many surfaces of action (for example, adhesion pad), and these can be arranged by the pattern of the location of the arbitration on the front face of a die site, and arbitration. The two one adhesion (many inside) pad 526 in a die site is shown in the drawing.

[0142] Before simplifying a die site to each semi-conductor die, in order to examine a die site, the technique of the number of limitation is known. It is embedded by the technique of the

typical conventional technique at a ceramic substrate, manufacture of the probe card insertion which has two or more tungstens "a needle" extended from there follows on it, and each needle makes temporary connection to the given pad of the adhesion pads. Lead time although manufactured, complicated [this probe card insertion is expensive, and / a little] and considerable although those costs become comparatively high as the result and they are obtained will start. When the adhesion pad of various many ways which are possible in a semi-conductor die is given, unique probe card insertion is needed for the array of each ****.

[0143] The speed which manufactures a peculiar semi-conductor die is a short duration, and makes conspicuous the urgent demand to a probe card simple, although manufactured, and cheap. As probe card insertion, using a spacing converter (506) and a mediation object (504) copes with this demand that cannot be inhibited head-on. At the time of use, the mediation object 504 is arranged in the up (seeing by a diagram) front face of a probe card 502, and the spacing transducer 506 is accumulated on the crowning (seeing by a diagram) of 504 besides mediation so that the pressure contact with the contact pad 520 of the spacing transducer 506 and dependability the interconnect element 514 makes the pressure contact with the sufficient contact terminal 510 of a probe card 502 and dependability, and sufficient [the interconnect element 516] may be made. These components are accumulated, although the pressure contact with this sufficient dependability is guaranteed, the device of suitable arbitration can be used, and the suitable device is explained to it below.

[0144] The probe card assembly 500 contains the following main components, in order to accumulate the mediation object 504 and the spacing transducer 506 on a probe card 502. Namely, the regions-of-back mounting plate 530 made from an ingredient with strong stainless steel etc., Plurality containing the actuator mounting plate 532 made from an ingredient with strong stainless steel etc., the anterior part mounting plate 534 made from an ingredient with strong stainless steel etc., the external differential screw element 536, and the internal differential screw element 538 (although it is two of many in illustration) The mounting ring 540 which three are suitably manufactured from an ingredient with a differential screw [being suitable] and elasticity, such as phosphor bronze, and has one pattern of a tab (un-illustrating) with the elasticity extended from there, As the screw 542 of the plurality (illustration many inside two) for holding the mounting ring 540 with the spacing transducer 506 caught among them by the anterior part mounting plate 534, and arbitration, in order to absorb manufacture tolerance It is the pivot ball 546 of plurality (illustration many inside two) arranged by the mounting ring 540, the spacer ring 544 arranged between the spacing transducers 506, and the crowning (seeing by a diagram) of a differential screw (for example, crowning of the internal differential screw element 538).

[0145] The regions-of-back mounting plate 530 is the metal plate or ring (it illustrates as a ring) arranged in the lower (it is illustration like) front face of a probe card 502. The hole 548 of plurality (illustration many inside one) extends through a regions-of-back mounting plate.

[0146] The actuator mounting plate 532 is the metal plate or ring (it illustrates as a ring) arranged in the lower (it is illustration like) front face of the regions-of-back mounting plate 530. The hole 550 of plurality (illustration many inside one) extends through an actuator mounting plate. At the time of use, the actuator mounting plate 532 is the suitable method of arbitration with a screw (from the drawing, omitted for clear-izing of instantiation) etc., and is fixed to the regions-of-back mounting plate 530.

[0147] the anterior part mounting plate 534 is strong -- it is a metaled ring suitably. It is the suitable method of arbitration with the screw (from the drawing, omitted for clear-izing of instantiation) which penetrates the corresponding hole (omitted from the drawing for clear-izing of instantiation) where the anterior part mounting plate 534 minded the probe card 502 at the time of use. It is fixed to the regions-of-back mounting plate 530, and a probe card 502 is certainly caught by it between the anterior part mounting plate 534 and the regions-of-back mounting plate 530.

[0148] The anterior part mounting plate 534 has the flat lower (seeing by a diagram) front face arranged to the up (seeing by a diagram) front face of a probe card 502. the anterior part mounting plate 534 has big central opening through it like illustration, and this is prescribed by

dimension arrangement **** and the internal edge 552 that two or more contact terminals 510 of a probe card 502 should make it possible that it is in central opening of the anterior part mounting plate 534.
[0149] As mentioned above, the anterior part mounting plate 534 is the ring-like structure of having a flat lower (seeing by a diagram) front face. It distinguishs between the up (seeing by a diagram) front face of the anterior part mounting plate 534, and the anterior part mounting plate is thick (it sees by a diagram and is vertical magnitude) in the external field rather than the contrant region on it. a level difference or a shoulder is arranged in the location of a dotted line (it writes by 554), and the spacing converter 506 removes the external field of an anterior part mounting plate, and appears on the contrant region of the anterior part mounting plate 534 -- possible -- it should carry out -- dimension arrangement **** (however, although it thinks that it understands, a spacing converter appears on the pivot ball 546 in fact).
[0150] The hole 554 of plurality (illustration many inside one) minds the anterior part mounting plate 534 partially at least. It extends to the external field of the anterior part mounting plate 534 (these holes are shown with the drawing that it extends without minding the anterior part mounting plate 534 partially), and these receive the edge of two or more corresponding screws 542 from the up (seeing by a diagram) front face like understanding. Because of this purpose, a hole 554 is a chasing hole. It becomes possible to fix to an anterior part mounting plate in the mounting ring 540, therefore to press the spacing transducer 506 to a probe card 502 by this.
[0151] Alignment of the hole 558 of plurality (illustration many inside one) is carried out to the corresponding hole 560 of the plurality (illustration many inside one) which extends completely through the thick contrant region of the anterior part mounting plate 534, and is extended through a probe card 502, and alignment is carried out to the hole 548 in a regions-of-back mounting plate, and the hole 550 in the actuator mounting plate 538 at order.
[0152] The pivot ball 546 is loosely arranged within the adjusted hole 558 and 560 in an edge on the internal differential screw element 538 (seeing by a diagram). It lets the external differential screw element 536 pass into the hole (chasing) 550 of the actuator mounting plate 532, and lets the internal differential screw element 538 pass into the chasing boa of the external differential screw element 536. Thus, very detailed adjustment can be made in the location of each pivot ball 546. For example, the external differential screw element 536 has the external screw thread of 72 screws / inch, and the internal differential screw element 538 has the external screw thread of 80 screws / inch. Location change of the net of a corresponding pivot ball becomes "plus" 1/72 (0.0139) inch "minus" 1 / 80 (0.0125) inches, i.e., 0.0014 inches, by advancing one rotation and the external differential screw element 536 into the actuator mounting plate 532, and maintaining the internal differential corresponding screw element 538 at a quiescent state (facing the actuator mounting plate 532). By this, the easy and precise adjustment of the smoothness of the spacing converter 506 which carried out field opposite is attained at a probe card 502. Therefore, repositioning at the tip (it sees by a diagram and is upper limit) of a probe (interconnect element) becomes possible, without changing the orientation of a probe card 502. The alternative device for adjusting this description, the technique for carrying out alignment at the tip of a probe, and the smoothness of a spacing converter

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[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view of a longitudinal part including the end of an interconnect element according to one example of this invention.
[Drawing 2] It is the sectional view of a longitudinal part including the end of an interconnect element according to other examples of this invention.
[Drawing 3] It is the sectional view of a longitudinal part including the end of an interconnect element according to other examples of this invention.
[Drawing 4] It is the sectional view of a longitudinal part including the end of an interconnect element according to other examples of this invention.
[Drawing 5] It is the sectional view of a longitudinal part including the end of an interconnect element according to other examples of this invention.
[Drawing 6] It is the sectional view of the interconnect element which is mounted in the terminal of an electronic component and has multilayering shell according to this invention.
[Drawing 7] It is the sectional view of the interconnect element which has the multilayering shell whose interlayer is a product made from dielectric materials according to this invention.
[Drawing 8] It is the perspective view of two or more interconnect elements mounted in an electronic component (for example, probe card insertion) according to this invention.
[Drawing 9] It is the instantiation sectional view of the 1st step of the technique for manufacturing an interconnect element according to this invention.
[Drawing 10] It is the sectional view of the further instantiation step of the technique of drawing 9 for manufacturing an interconnect element according to this invention.
[Drawing 11] It is the sectional view of the further instantiation step of the technique of drawing 10 for manufacturing an interconnect element according to this invention.
[Drawing 12] It is the sectional view of two or more interconnect elements of each, manufactured according to the technique of drawing 9 -11 according to this invention.
[Drawing 13] It is the sectional view of two or more instantiation interconnect elements which were manufactured according to the technique of drawing 9 -11 according to this invention, and were mutually related due to space regular.
[Drawing 14] According to this invention, it is the sectional view of the alternative example for manufacturing an interconnect element, and one edge of one interconnect element is shown.
[Drawing 15] It is the sectional view of one example of the mediation object according to this invention.
[Drawing 16] It is the sectional view of other examples of the mediation object according to this invention.
[Drawing 17] It is the sectional view of other examples of the mediation object according to this invention.
[Drawing 18] It is the sectional view of one example of the all-inclusive spacing converter according to this invention.
[Drawing 19] It is the exploded view of the probe card assembly of this invention showing a cross section partially.
[Drawing 20] It is the perspective view of one spacing converter component which was suitable

for using in the probe card assembly of drawing 19 according to this invention.
[Drawing 21] It is the perspective view of other spacing converter components which were suitable for using in the probe card assembly of drawing 19 according to this invention.
[Drawing 22] It is the bottom view of one spacing converter which was suitable for using in the probe card assembly of drawing 19 according to this invention.
[Drawing 23] While on the typical up front face of a mediation object substrate for using in the probe card assembly of drawing 19 according to this invention, or the front face of lower, they are one of bottom views.
[Drawing 24] It is the fragmentary sectional view of the mediation object component shown in drawing 23 according to this invention.
[Drawing 25] It is the partial cross section and partial schematic diagram of one probe card assembly which had consistency although it uses according to this invention in case a semiconductor wafer is examined, and was similar to the probe card assembly shown in drawing 19.
[Drawing 26] It is the partial cross section and partial schematic diagram of technique for adjusting the orientation of a spacing converter component automatically according to this invention.
[Drawing 27] It is the sectional view of the technique for manufacturing tip structure to a probe element according to this invention.
[Drawing 28] It is the sectional view of the further step in the technique of drawing 27 according to this invention.
[Drawing 29] They are a cross section and the side elevation showing the whole partially partially [the spacing converter component according to this invention].
[Drawing 30] They are a cross section and the side elevation showing the whole partially partially [the spacing converter component of drawing 29 connected with the tip structure of drawing 28 where this invention was followed].
[Drawing 31] They are a cross section and the side elevation showing the whole partially partially [the further step at the time of connecting the spacing converter component of drawing 29 connected with the tip structure of drawing 28 according to this invention].
[Description of Notations]
500 Probe Card Assembly
502 Probe Card
504 Mediation Object
506 Spacing Converter
508 Semiconductor Wafer
524 Probe Element

[Translation done.]

* NOTICES *

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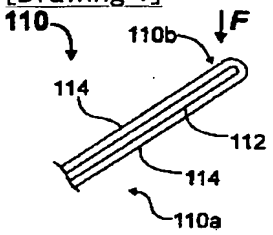
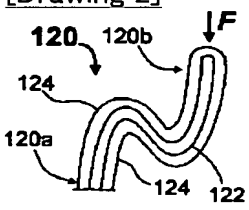
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

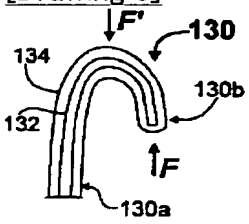
[Drawing 1]



[Drawing 2]



[Drawing 3]



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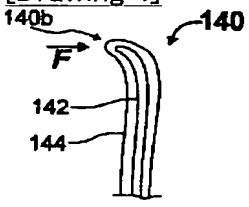
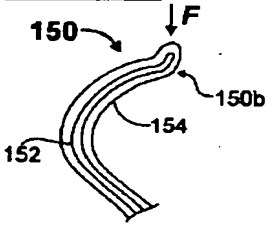
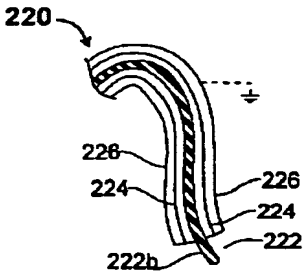


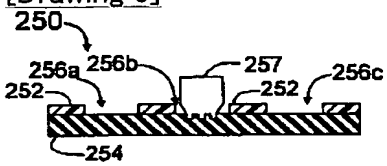
[Drawing 5]



[Drawing 7]



[Drawing 9]



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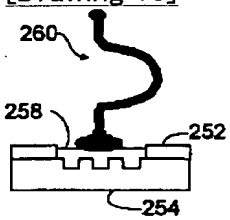
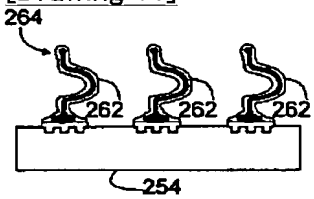
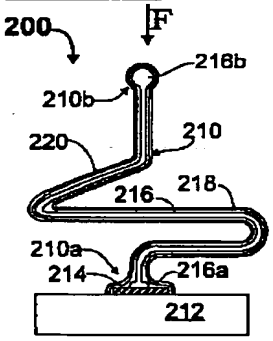


[Drawing 11]



[Drawing 6]



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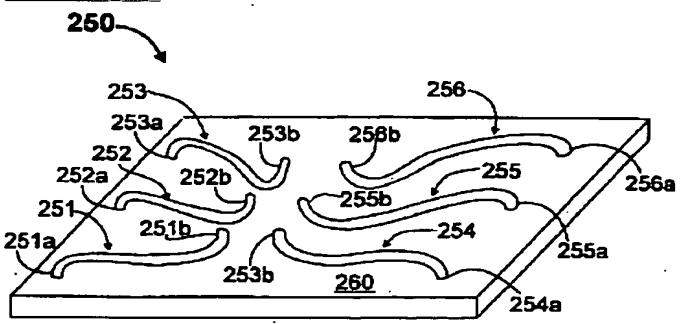
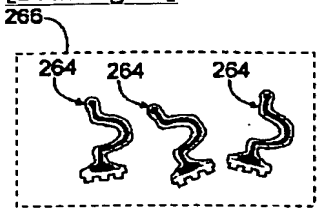
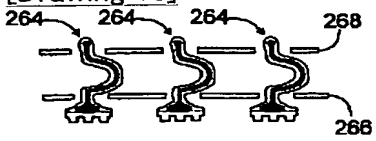


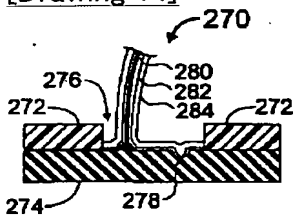
[Drawing 12]



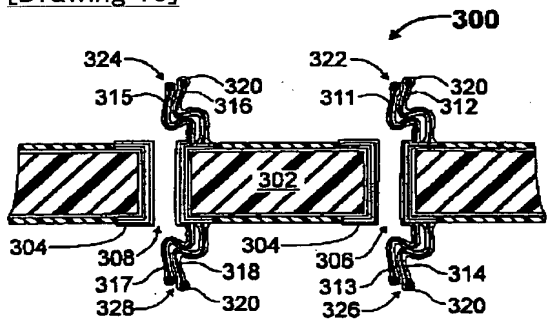
[Drawing 13]



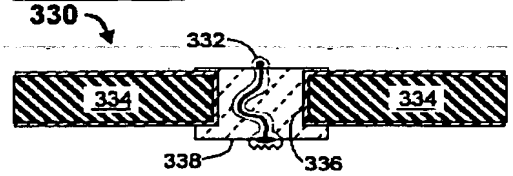
[Drawing 14]



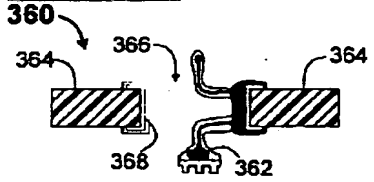
[Drawing 15]



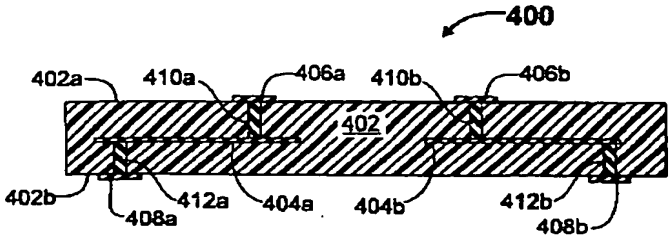
[Drawing 16]



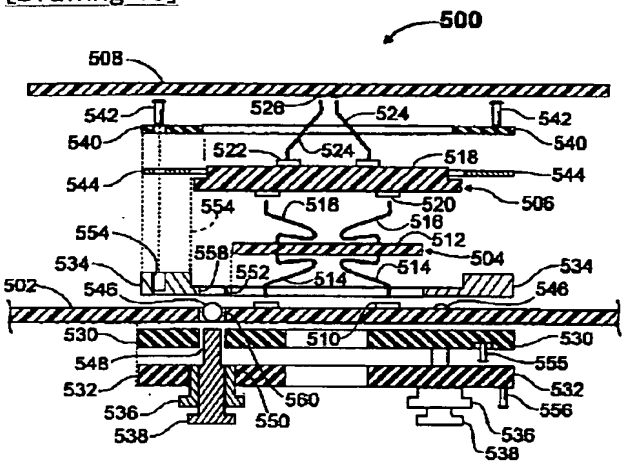
[Drawing 17]



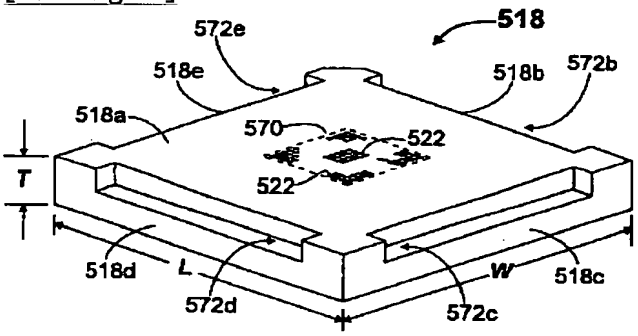
[Drawing 18]



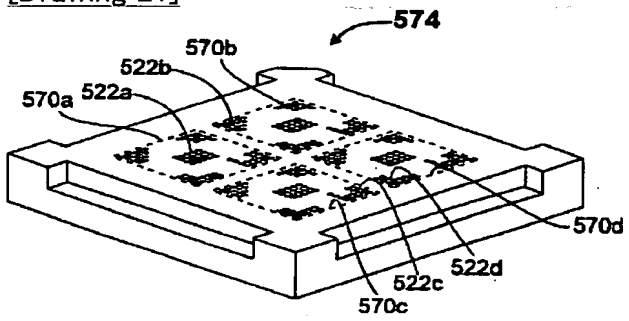
[Drawing 19]



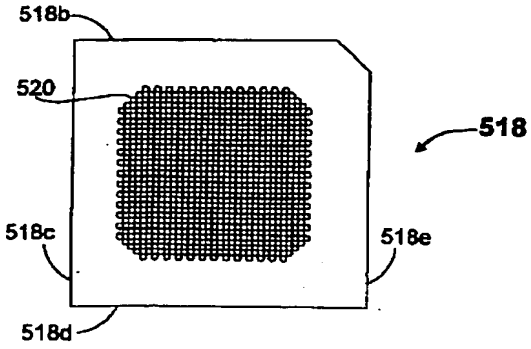
[Drawing 20]



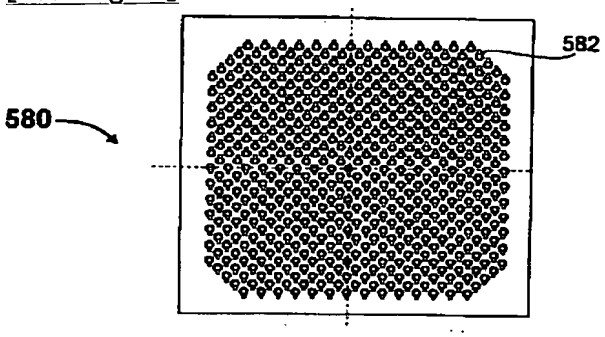
[Drawing 21]



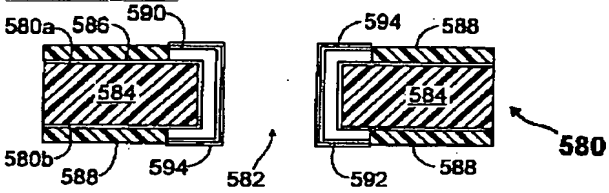
[Drawing 22]



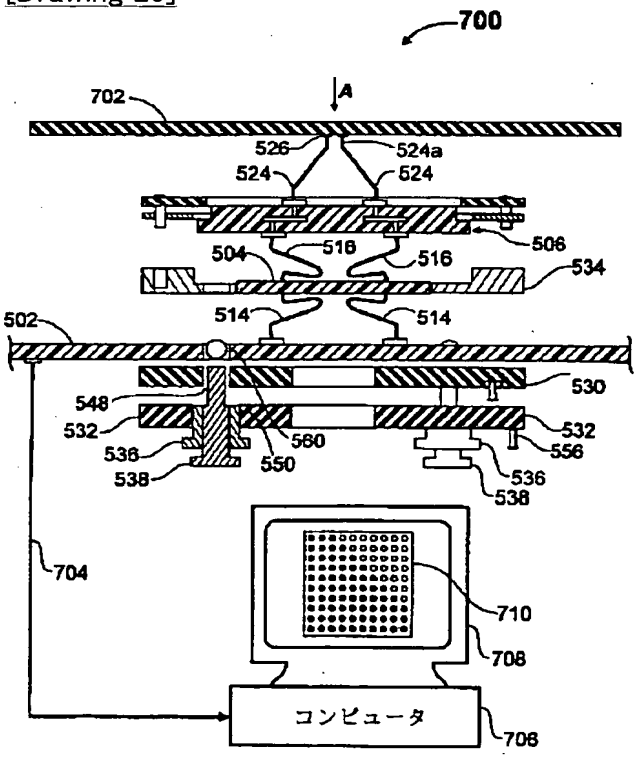
[Drawing 23]



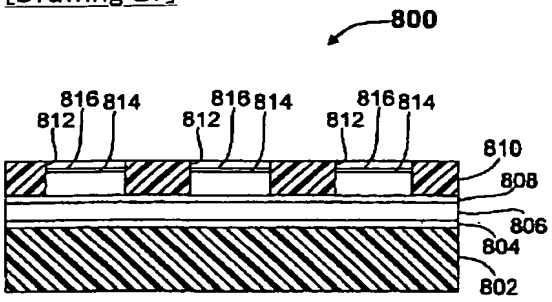
[Drawing 24]



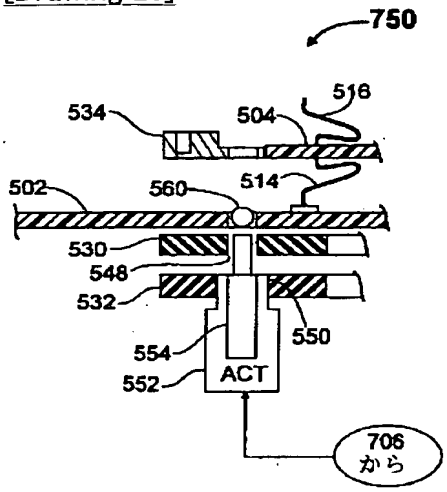
[Drawing 25]



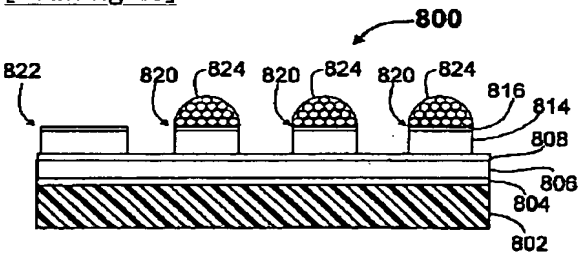
[Drawing 27]



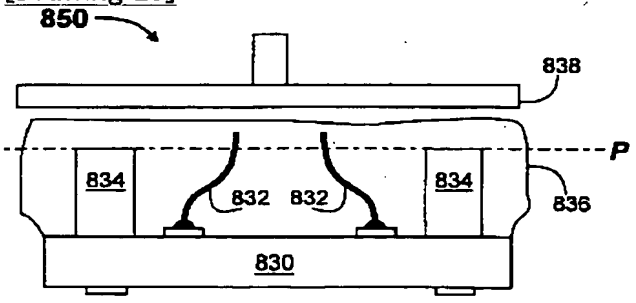
[Drawing 26]



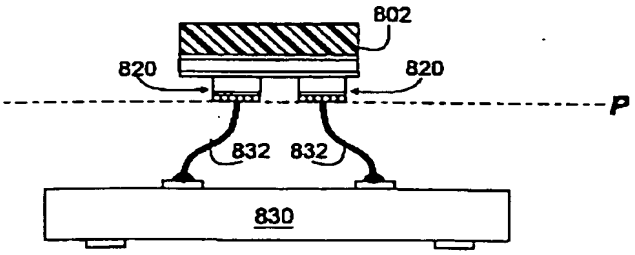
[Drawing 28]



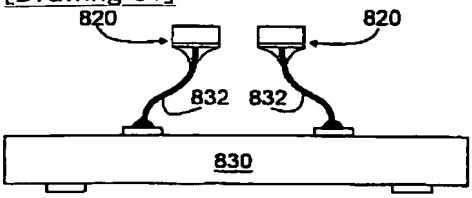
[Drawing 29]



[Drawing 30]



[Drawing 31]



[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

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[Section partition] The 1st partition of the 7th section
[Publication date] January 17, Heisei 15 (2003. 1.17)

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G01R 1/06
31/28
H01L 21/66
H01R 13/05
33/74
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[FI]

H01R 23/68 303 E
G01R 1/06 A
H01L 21/66 B
H01R 13/05 A
33/74 B
G01R 31/28 K

[Procedure revision]
[Filing Date] October 2, Heisei 14 (2002. 10.2)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] In the spacing converter for probe card assemblies,
The spacing converter substrate which has two or more 1st terminals arranged in an up front face, a lower front face, and this up front face, and two or more 2nd terminals arranged in the above-mentioned lower front face,
contact structure with two or more 1st stability directly mounted in two or more terminals of the above 1st — since — the becoming spacing converter.
[Claim 2] The spacing converter according to claim 1 which consists of tip structure mounted in

the edge of contact structure with said two or more 1st stability further.
[Claim 3] The contact structure with said two or more 1st stability is a spacing converter according to claim 1 which is a compound interconnect element.
[Claim 4] The contact structure with said two or more 1st stability is a spacing converter according to claim 1 manufactured on a sacrifice substrate before mounting contact structure with said two or more 1st stability in said two or more 1st terminals directly.
[Claim 5] The spacing converter according to claim 1 which consists of contact structure with two or more 2nd stability directly mounted in said two or more 2nd terminals further.
[Claim 6] The contact structure with said two or more 2nd stability is a spacing converter according to claim 1 which is a compound interconnect element.
[Claim 7] The contact structure with said two or more 2nd stability is a spacing converter according to claim 1 manufactured on a sacrifice substrate before mounting contact structure with said two or more 2nd stability in said two or more 2nd terminals directly.
[Claim 8] In a probe card assembly,
The probe card which has two or more contact terminals which are probe cards and can be set on an up front face, a lower front face, and this up front face,
The mediation object which has the contact structure which is a mediation object and has two or more 1st stability extended from an up front face, a lower front face, and the lower front face of a mediation object, and contact structure with two or more 2nd stability extended from the up front face of a mediation object,
Two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter, and the spacing converter which has contact structure with two or more 3rd stability extended from the up front face of a spacing converter,
The contact structure with two or more stability of the above 1st is bringing about the pressure connection with the contact terminal of the above-mentioned probe card,
The contact structure with two or more stability of the above 2nd is bringing about the pressure connection with the contact pad of the above-mentioned spacing converter,
since -- the becoming probe card assembly.
[Claim 9] The contact structure with said two or more 3rd stability is a probe card assembly according to claim 8 directly mounted in the terminal in the up front face of said spacing transducer.
[Claim 10] The contact structure with said two or more 1st stability is a probe card assembly according to claim 8 which is a compound interconnect element.
[Claim 11] The contact structure with said two or more 2nd stability is a probe card assembly according to claim 8 which is a compound interconnect element.
[Claim 12] The contact structure with said two or more 3rd stability is a probe card assembly according to claim 8 which is a compound interconnect element.
[Claim 13] Each of contact structure with said two or more 1st stability is a probe card assembly according to claim 8 which are at least two compound interconnect elements.
[Claim 14] Each of contact structure with said two or more 2nd stability is a probe card assembly according to claim 8 which are at least two compound interconnect elements.
[Claim 15] The anterior part mounting plate with which it is manufactured from a strong ingredient, it has an up front face and a lower front face, and this lower front face is arranged against said up front face of said probe card,
The means for fixing the above-mentioned anterior part mounting plate to said up front face of said probe card,
The means for pressing said spacing converter against said up front face of said probe card,
since -- the probe card assembly according to claim 8 which becomes further.
[Claim 16] Said anterior part mounting plate is a probe card assembly according to claim 15 manufactured from stainless steel.
[Claim 17] Said means for pressing said spacing converter,
Mounting ring,
The above caught among them to said anterior part mounting plate in this mounting ring

two or more screws held with a spacing transducer — since — the becoming probe card assembly according to claim 15.
[Claim 18] Said mounting ring is a probe card assembly according to claim 17 manufactured from an elastic ingredient.
[Claim 19] The probe card assembly according to claim 17 which consists of said mounting ring and a spacer ring arranged between said spacing transducers further.
[Claim 20] Said means for fixing said anterior part mounting plate is a regions-of-back mounting plate with which it has an up front face and a lower front face, and this up front face is arranged against said lower front face of said probe card,
two or more screws extended through said probe card between said anterior part mounting plate and the above-mentioned regions-of-back mounting plate -- since -- the becoming probe card assembly according to claim 15.
[Claim 21] Said regions-of-back mounting plate is a probe card assembly according to claim 20 manufactured from stainless steel.
[Claim 22] The probe card assembly according to claim 8 which consists of a means for adjusting the smoothness of said spacing transducer further, without changing the orientation of said probe card.
[Claim 23] It is the probe card assembly according to claim 22 which contains the external differential screw element and the internal differential screw element with which the each acts on the lower front face of said spacing transducer by said means for adjusting the smoothness of said spacing transducer consisting of two or more differential screws.
[Claim 24] The probe card assembly according to claim 23 which consists of two or more pivot balls arranged in the edge of the differential screw element of said interior further.
[Claim 25] It is the probe card assembly according to claim 23 with which it consists of an actuator mounting plate arranged immediately in the bottom of said probe card further, and screw through [of said differential screw] is carried out into this actuator mounting plate.
[Claim 26] Said means for adjusting the smoothness of said spacing converter is a probe card assembly according to claim 22 which consists of two or more actuators which answer a computer and act on the lower front face of said spacing converter.
[Claim 27] It is the 2nd pitch, and is arranged in the up front face of said spacing transducer, and, for the 1st pitch of the above, the contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing transducer, and has said two or more 3rd stability is a larger probe card assembly according to claim 8 than the 2nd pitch of the above.
[Claim 28] It is the 2nd pitch, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which the contact structure with said two or more 1st stability is the 1st pitch, is arranged in the lower front face of said mediation object, and has said two or more 2nd stability is the same probe card assembly according to claim 8 as the 2nd pitch of the above.
[Claim 29] The contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing converter, and has said two or more 3rd stability The contact structure which is arranged in the up front face of said spacing converter, and has said two or more 1st stability in the 2nd pitch It is the 1st pitch of the above, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which is arranged in the lower front face of said mediation object, and has said two or more 2nd stability in the 1st pitch of the above is a larger probe card assembly according to claim 8 than the 2nd pitch of the above.
[Claim 30] In a probe card kit,
The spacing converter which has contact structure with two or more 1st stability extended from two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter, and the up front face of a spacing converter, and was adapted for using to two or more surfaces of action on a semiconductor wafer, and the tip of contact structure with two or more stability of the above 1st which makes pressure contact,
Are a mediation object and it has contact structure with two or more 2nd stability extended from

an up front face, a lower front face, and the up front face of a mediation object. Make two or more above-mentioned contact pads and pressure connection in the lower front face of the above-mentioned spacing converter. It is adapted for using to the tip of contact structure with two or more stability of the above 2nd, and has contact structure with two or more 3rd stability extended from the lower front face of a mediation object. the mediation object which was adapted for using to two or more terminals on a probe card, and the tip of two or more 3rd contact structures which make pressure connection -- since -- the becoming probe card kit.
[Claim 31] It is the 2nd pitch, and is arranged in the up front face of said spacing transducer, and, for the 1st pitch of the above, the contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing transducer, and has said two or more 1st stability is a larger probe card kit according to claim 30 than the 2nd pitch of the above.
[Claim 32] It is the 2nd pitch, and is arranged in the up front face of said mediation object, and, for the 1st pitch of the above, the contact structure which said two or more 3rd contact structures have stability, and is the 1st pitch, is arranged in the lower front face of said mediation object, and has said two or more 2nd stability is the same probe card kit according to claim 30 as the 2nd pitch of the above.
[Claim 33] The contact structure which said contact pad is the 1st pitch, is arranged in the lower front face of said spacing converter, and has said two or more 1st stability It is arranged in the up front face of said spacing converter in the 2nd pitch. Said two or more 3rd contact structures The contact structure which there is stability, and is arranged in the lower front face of said mediation object, and has said two or more 2nd stability in the 1st pitch It is arranged in the up front face of said mediation object in the 1st pitch, and the 1st pitch of the above is a larger probe card kit according to claim 30 than the 2nd pitch of the above.
[Claim 34] In contact structure with stability,
The compound interconnect element which has an edge,
Tip structure of the preliminary manufacture connected with the above-mentioned edge of this compound interconnect element,
since -- contact structure with the becoming stability.
[Claim 35] The contact structure with said stability is contact structure with stability according to claim 34 which is the probe element mounted in a spacing transducer.
[Claim 36] In the approach of manufacturing tip structure to the edge of contact structure,
The step which deposits at least one layer of at least one electrical conducting material on a silicon wafer,
the above -- the step which deposits the layer of a masking material on the crowning of one conductive layer even if few,
The step which carries out patterning of the opening in the above-mentioned masking material,
The step which deposits at least one layer of at least one electrical conducting material in the above-mentioned opening,
The approach containing the step which removes the above-mentioned masking material.
[Claim 37] The approach according to claim 36 of containing further the step which deposits a connection ingredient on said at least one layer of at least one electrical conducting material deposited in said opening before.
[Claim 38] The approach according to claim 37 of containing further the step which connects said tip structure with the edge of said contact structure.
[Claim 39] Said contact structure is the approach according to claim 38 of being contact structure with stability.
[Claim 40] Said contact structure is the approach according to claim 38 of being a compound interconnect element.
[Claim 41] Said contact structure is the approach according to claim 38 of being the contact structure with stability arranged by the crowning of the spacing converter of a probe card assembly.
[Claim 42] The probe card containing two or more electric contact,
The probe substrate which has two or more long and slender elastic probe elements,
The probe card assembly which consists of obedient interconnect structure which it is arranged

between said probe cards and said probe substrates, and is connected electrically [one and said electric contact of said probe element / one].
[Claim 43] The probe card assembly according to claim 42 with which said obedient interconnect structure contains two or more long and slender interconnect elements extended from both sides of said interconnect structure.
[Claim 44] The probe card assembly of the long and slender interconnect element of said plurality according to claim 43 by which said long and slender element is arranged, respectively so that said obedient interconnect structure may carry out opening passage, and the both ends of said long and slender interconnect element are ****(ed) from both sides of said interconnect structure.
[Claim 45] The probe card assembly according to claim 43 with which the long and slender interconnect element of said plurality does the force to said probe card and said probe structure.

[Claim 46] The probe card assembly according to claim 45 said whose force is spring force.
[Claim 47] A probe card assembly according to claim 43 with said long and slender elastic interconnect element.
[Claim 48] Covering which at least one of said the long and slender interconnect elements becomes from the core which consists of the 1st ingredient, and the 2nd ingredient is included, and it is a probe card assembly according to claim 47 with this 2nd ingredient more elastic than this 1st ingredient.
[Claim 49] A probe card assembly including a means to adjust the inclination of said probe card to said probe card furthermore according to claim 42.
[Claim 50] The probe card assembly containing at least one movable element arranged so that change may furthermore be given to the inclination of said probe card to said probe card according to claim 42.
[Claim 51] The probe card assembly according to claim 50 with which the screw thread is attached to said movable element.
[Claim 52] The probe card assembly according to claim 50 with which said movable element includes ****.
[Claim 53] The probe card assembly according to claim 52 with which said **** includes actuation ****.
[Claim 54] The probe card assembly containing at least one movable element arranged so that migration in the 1st direction of the movable element concerned may furthermore move said some of probe substrates [at least] to the direction of said probe card according to claim 42.
[Claim 55] The probe card assembly according to claim 54 with which migration in the 2nd direction of said movable element furthermore enables said some of probe substrates [at least] to separate from said probe card.
[Claim 56] The probe card assembly according to claim 42 which contains two or more movable elements with which each is arranged so that the location of the part of said probe substrate to the part of said probe card may be affected.
[Claim 57] A probe card assembly including the servo mechanism arranged so that the location of said probe substrate may furthermore be adjusted to said probe card according to claim 42.
[Claim 58] The probe card assembly containing the electrostrictive actuator arranged so that the location of said probe substrate may furthermore be adjusted to said probe card according to claim 42.
[Claim 59] The probe card assembly according to claim 42 with which said probe substrate contains a spacing transducer.
[Claim 60] Covering which said probe element becomes from the core which consists of the 1st ingredient, and the 2nd ingredient is included, and it is a probe card assembly according to claim 42 with this 2nd ingredient more elastic than this 1st ingredient.
[Claim 61] The probe card means for making a circuit tester contact electrically,
The probe substrate means for preparing long and slender elastic electric contact in the semiconductor device under a trial,
The probe card assembly which consists of an interconnect means for connecting electrically

said probe card means and said probe substrate means obediently.
[Claim 62] The probe card assembly according to claim 61 with which said interconnect means contains two or more long and slender interconnect elements to which each connects electrically one of said the electric contact of the one and said probe card means of said electric contact of said probe substrate means elastically.
[Claim 63] A probe card assembly including the means for furthermore adjusting the inclination of said probe substrate means to said probe card means according to claim 61.
[Claim 64] The probe card containing two or more electric contact,
the probe substrate which has two or more long and slender elastic probe elements while being fixed to said probe card movable, and this thin **** — the thing of an elastic probe element through which it flows with one of said the electric contact, respectively,
The probe card assembly which consists of a movable element arranged so that change may be given to the inclination of said probe substrate to said probe card.
[Claim 65] The probe card assembly according to claim 64 to which migration in the 1st direction of said movable element moves said some of probe substrates [at least] so that it may separate from said probe card.
[Claim 66] The probe card assembly according to claim 65 with which migration in the 2nd direction of said movable element moves said some of probe substrates [at least] to the direction of said probe card.
[Claim 67] The probe card assembly according to claim 64 with which the screw thread is attached to said movable element.
[Claim 68] The probe card assembly according to claim 64 with which said movable element includes ****.
[Claim 69] The probe card assembly according to claim 68 with which said **** includes actuation ****.
[Claim 70] The probe card assembly according to claim 64 with which said movable element includes servo mechanism.
[Claim 71] The probe card assembly according to claim 64 with which said movable element contains an electrostrictive actuator.
[Claim 72] The probe card assembly according to claim 64 which contains two or more movable elements with which each is arranged so that the location of the part of said probe substrate to the part of said probe card may be affected.
[Claim 73] The probe card assembly according to claim 64 said whose probe substrate is a spacing transducer.
[Claim 74] Covering which said probe element becomes from the core which consists of the 1st ingredient, and the 2nd ingredient is included, and it is a probe card assembly according to claim 64 with this 2nd ingredient more elastic than this 1st ingredient.
[Claim 75] The probe card means for preparing a semi-conductor circuit tester an interface,
The probe substrate means and said probe element for supporting two or more long and slender elastic probe elements are said thing [that carry out a probe card flow and said probe substrate means is being fixed to said probe card means movable],
The probe card assembly which consists of a means for adjusting the inclination of said probe substrate means to said probe card means.
[Claim 76] Covering which said probe element becomes from the core which consists of the 1st ingredient, and the 2nd ingredient is included, and it is a probe card assembly according to claim 75 with this 2nd ingredient more elastic than this 1st ingredient.
[Claim 77] The probe card assembly according to claim 75 which is furthermore arranged between said probe card means and said probe substrate means, and consists of a mediation object means which does the force to said probe card means and said probe substrate means.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

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[Proposed Amendment]
[Claim(s)]
[Claim 1] In the spacing converter for probe card assemblies,
The spacing converter substrate which has two or more 1st terminals arranged in an up front face, a lower front face, and this up front face, and two or more 2nd terminals arranged in the above-mentioned lower front face,
Contact structure with two or more 1st stability directly mounted in two or more terminals of the above 1st,
since -- the becoming spacing converter.

[Claim 2] In a probe card assembly,
The probe card which has two or more contact terminals which are probe cards and can be set on an up front face, a lower front face, and this up front face,
The mediation object which has the contact structure which is a mediation object and has two or more 1st stability extended from an up front face, a lower front face, and the lower front face of a mediation object, and contact structure with two or more 2nd stability extended from the up front face of a mediation object,
It has the spacing converter which has contact structure with two or more 3rd stability extended from two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter, and the up front face of a spacing converter,
The contact structure with two or more stability of the above 1st brings about the pressure connection with the contact terminal of the above-mentioned probe card,
The contact structure with two or more stability of the above 2nd brings about the pressure connection with the contact pad of the above-mentioned spacing converter,
Probe card assembly.
[Claim 3] In a probe card kit,
The spacing converter which has contact structure with two or more 1st stability extended from two or more contact pads which are spacing converters and are arranged in an up front face, a lower front face, and the lower front face of a spacing converter, and the up front face of a spacing converter, and was adapted for using to two or more surfaces of action on a semiconductor wafer, and the tip of contact structure with two or more stability of the above 1st which makes pressure contact,
Are a mediation object and it has contact structure with two or more 2nd stability extended from an up front face, a lower front face, and the up front face of a mediation object. Make two or more above-mentioned contact pads and pressure connection in the lower front face of the above-mentioned spacing converter. It is adapted for using to the tip of contact structure with two or more stability of the above 2nd, and has contact structure with two or more 3rd stability extended from the lower front face of a mediation object. The mediation object which was adapted for using to two or more terminals on a probe card, and the tip of contact structure with two or more 3rd stability which makes pressure connection,
since -- the becoming probe card kit.
[Claim 4] In contact structure with stability,
The compound interconnect element which has an edge,
the tip structure of the preliminary manufacture connected with the above-mentioned edge of this compound interconnect element -- since -- contact structure with the becoming stability.
[Claim 5] The step which deposits at least one layer of at least one electrical conducting material on a silicon wafer in the approach of manufacturing tip structure to the edge of contact structure,
the above -- the step which deposits the layer of a masking material on the crowning of one conductive layer even if few,
The step which carries out patterning of the opening in the above-mentioned masking material,
The step which deposits at least one layer of at least one electrical conducting material in the above-mentioned opening,
The step which removes the above-mentioned masking material,
The ****** approach.
[Claim 6] The probe card containing two or more electric contact,
The probe substrate which has two or more long and slender elastic probe elements,
the obedient interconnect structure which it is arranged between said probe cards and said probe substrates, and is connected electrically [one and said electric contact of said probe element / one] -- since -- the becoming probe card assembly.
[Claim 7] The probe card means for making a circuit tester contact electrically,
The probe substrate means for preparing long and slender elastic electric contact in the semiconductor device under a trial,

The interconnect means for connecting electrically said probe card means and said probe substrate means obediently,
since -- the becoming probe card assembly.
[Claim 8] The probe card containing two or more electric contact,
while being fixed to said probe card movable -- two or more long and slender elastic probe elements -- having -- this thin **** -- the probe substrate of an elastic probe element which flows with one of said the electric contact, respectively,
The movable element arranged so that change may be given to the inclination of said probe substrate to said probe card,
since -- the becoming probe card assembly.
[Claim 9] The probe card means for preparing a semi-conductor circuit tester an interface,
A probe substrate means by which support two or more long and slender elastic probe elements, and said probe element flows for said probe card means, and is being fixed to said probe card means movable,
The means for adjusting the inclination of said probe substrate means to said probe card means,
since -- the becoming probe card assembly.

[Translation done.]

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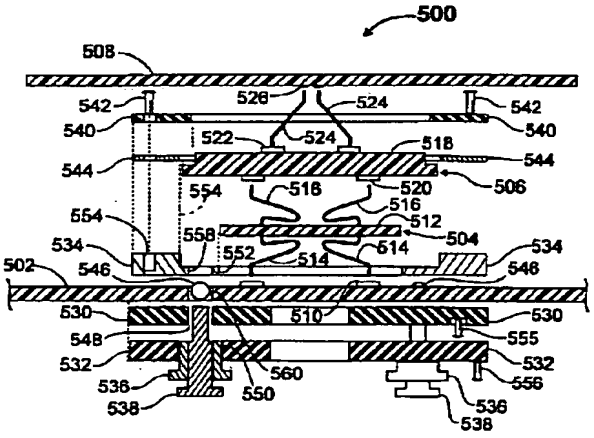
(54)【発明の名称】　プローブカード・アセンブリ及びキット、及びそれらを用いる方法

(57)【要約】
【課題】　プローブ要素の先端の配向を、プローブカードの位置を変更することなく可能にする、半導体素子にプローブを当てるための技法を提供する。
【解決手段】　本発明によれば、プローブカード・アセンブリには、上部表面、下部表面、及びその上部表面における複数の端子を有する、プローブカード（電子コンポーネント）と、上部表面、下部表面、その下部表面における端子から延伸する、第１の複数の復元性のある接触構造、及びその上部表面における端子から延伸する、第２の複数の復元性のある接触構造を有する、介在体（電子コンポーネント）と、上部表面、下部表面、その下部表面に配設される複数の接触パッド（端子）、及びその上部表面における端子から延伸する、第３の復元性のある接触構造（プローブ要素）を有する、間隔変換器とが含まれる。



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【特許請求の範囲】

【請求項１】　プローブカード・アセンブリ用の間隔変換器において、

上部表面、下部表面、該上部表面に配設される第１の複数の端子、及び上記下部表面に配設される第２の複数の端子を有する、間隔変換器基板と、

上記第１の複数の端子に直接実装される、第１の複数の復元性のある接触構造と、からなる間隔変換器。

【請求項２】　前記第１の複数の復元性のある接触構造の端部に実装される、先端構造から更になる、請求項１に記載の間隔変換器。

【請求項３】　前記第１の複数の復元性のある接触構造は、複合相互接続要素である、請求項１に記載の間隔変換器。

【請求項４】　前記第１の複数の復元性のある接触構造は、前記第１の複数の端子に直接、前記第１の複数の復元性のある接触構造を実装する前に、犠牲基板上に製造される、請求項１に記載の間隔変換器。

【請求項５】　前記第２の複数の端子に直接実装される、第２の複数の復元性のある接触構造から更になる、請求項１に記載の間隔変換器。

【請求項６】　前記第２の複数の復元性のある接触構造は、複合相互接続要素である、請求項１に記載の間隔変換器。

【請求項７】　前記第２の複数の復元性のある接触構造は、前記第２の複数の端子に直接、前記第２の複数の復元性のある接触構造を実装する前に、犠牲基板上に製造される、請求項１に記載の間隔変換器。

【請求項８】　プローブカード・アセンブリにおいて、

プローブカードであって、上部表面、下部表面、及び該上部表面における複数の接触端子を有するプローブカードと、

介在体であって、上部表面、下部表面、介在体の下部表面から延伸する第１の複数の復元性のある接触構造、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有する介在体と、

間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、及び間隔変換器の上部表面から延伸する第３の複数の復元性のある接触構造を有する間隔変換器と、

上記第１の複数の復元性のある接触構造は、上記プローブカードの接触端子との圧力接続をもたらすことと、

上記第２の複数の復元性のある接触構造は、上記間隔変換器の接触パッドとの圧力接続をもたらすことと、からなるプローブカード・アセンブリ。

【請求項９】　前記第３の複数の復元性のある接触構造は、前記間隔変換器の上部表面における端子に直接実装される、請求項８に記載のプローブカード・アセンブリ。

【請求項１０】　前記第１の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。

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【請求項１１】　前記第２の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。

【請求項１２】　前記第３の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。

【請求項１３】　前記第１の複数の復元性のある接触構造の各々は、少なくとも２つの複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。

【請求項１４】　前記第２の複数の復元性のある接触構造の各々は、少なくとも２つの複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。

【請求項１５】　堅固な材料から製作され、上部表面及び下部表面を有して、該下部表面が前記プローブカードの前記上部表面に対抗して配設される前部実装プレートと、

前記プローブカードの前記上部表面に、上記前部実装プレートを固定するための手段と、

前記プローブカードの前記上部表面に対抗して、前記間隔変換器を押圧するための手段と、から更になる、請求項８に記載のプローブカード・アセンブリ。

【請求項１６】　前記前部実装プレートは、ステンレス鋼から製作される、請求項１５に記載のプローブカード・アセンブリ。

【請求項１７】　前記間隔変換器を押圧するための前記手段は、

実装リングと、

該実装リングを前記前部実装プレートに対して、それらの間に捕捉される前記間隔変換器と共に保持する複数のネジと、からなる、請求項１５に記載のプローブカード・アセンブリ。

【請求項１８】　前記実装リングは、弾力のある材料から製作される、請求項１７に記載のプローブカード・アセンブリ。

【請求項１９】　前記実装リングと前記間隔変換器の間に配設される、スペーサリングから更になる、請求項１７に記載のプローブカード・アセンブリ。

【請求項２０】　前記前部実装プレートを固定するための前記手段は、

上部表面及び下部表面を有し、該上部表面が前記プローブカードの前記下部表面に対抗して配設される、背部実装プレートと、

前記プローブカードを介して、前記前部実装プレートと上記背部実装プレートの間で延伸する複数のネジと、からなる、請求項１５に記載のプローブカード・アセンブリ。

【請求項２１】　前記背部実装プレートは、ステンレス鋼から製作される、請求項２０に記載のプローブカード

・アセンブリ。

【請求項２２】　前記プローブカードの配向を変更することなく、前記間隔変換器の平面性を調整するための手段から更になる、請求項８に記載のプローブカード・アセンブリ。

【請求項２３】　前記間隔変換器の平面性を調整するための前記手段は、複数の差動ネジからなり、その各々は、前記間隔変換器の下部表面に作用する、外部の差動ネジ要素と内部の差動ネジ要素を含む、請求項２２に記載のプローブカード・アセンブリ。

【請求項２４】　前記内部の差動ネジ要素の端部に配設される、複数の枢軸球から更になる、請求項２３に記載のプローブカード・アセンブリ。

【請求項２５】　前記プローブカードの直ぐ下に配設されるアクチュエータ実装プレートから更になり、前記差動ネジは、該アクチュエータ実装プレート内へとネジ通しされる、請求項２３に記載のプローブカード・アセンブリ。

【請求項２６】　前記間隔変換器の平面性を調整するための前記手段は、コンピュータに応答して、前記間隔変換器の下部表面に作用する、複数のアクチュエータからなる、請求項２２に記載のプローブカード・アセンブリ。

【請求項２７】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第３の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項８に記載のプローブカード・アセンブリ。

【請求項２８】　前記第１の複数の復元性のある接触構造は、第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第２のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチと同一である、請求項８に記載のプローブカード・アセンブリ。

【請求項２９】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第３の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、前記第１の複数の復元性のある接触構造は、上記第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、上記第１のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項８に記載のプローブカード・アセンブリ。

【請求項３０】　プローブカード・キットにおいて、
間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、間隔変換器の上部表面から延伸する第１の複数の復元性のある接触構造を有して、半導体ウェーハ上の複数の接触領域と圧力接触をなす、上記第１の複数の復元性のある接触構造の先端に対して用いるのに適応した、間隔変換器と、
介在体であって、上部表面、下部表面、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有して、上記間隔変換器の下部表面における上記複数の接触パッドと圧力接続をなす、上記第２の複数の復元性のある接触構造の先端に対して用いるのに適応し、介在体の下部表面から延伸する第３の複数の復元性のある接触構造を有して、プローブカード上の複数の端子と圧力接続をなす、第３の複数の復元性のある接触構造の先端に対して用いるのに適応した、介在体と、からなるプローブカード・キット。

【請求項３１】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第１の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項３０に記載のプローブカード・キット。

【請求項３２】　前記第３の複数の復元性のある接触構造は、第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第２のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチと同一である、請求項３０に記載のプローブカード・キット。

【請求項３３】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第１の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、前記第３の複数の復元性のある接触構造は、第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第１のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項３０に記載のプローブカード・キット。

【請求項３４】　復元性のある接触構造において、端部を有する複合相互接続要素と、該複合相互接続要素の上記端部に連結される、予備製造の先端構造と、からなる復元性のある接触構造。

【請求項３５】　前記復元性のある接触構造は、間隔変換器に実装されるプローブ要素である、請求項３４に記載の復元性のある接触構造。

【請求項３６】　接触構造の端部に対して先端構造を製造する方法において、
シリコンウェーハ上に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、
上記少なくとも１つの導電層の頂部に、マスキング材料の層を堆積するステップと、
上記マスキング材料において開口をパターニングするステップと、
上記開口内に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、

上記マスキング材料を除去するステップと、を含む方法。

【請求項３７】　前記開口内に以前に堆積した少なくとも１つの導電材料の前記少なくとも１つの層上に、連結材料を堆積するステップを更に含む、請求項３６に記載の方法。

【請求項３８】　前記接触構造の端部に前記先端構造を連結するステップを更に含む、請求項３７に記載の方法。

【請求項３９】　前記接触構造は、復元性のある接触構造である、請求項３８に記載の方法。

【請求項４０】　前記接触構造は、複合相互接続要素である、請求項３８に記載の方法。

【請求項４１】　前記接触構造は、プローブカード・アセンブリの間隔変換器の頂部に配設される、復元性のある接触構造である、請求項３８に記載の方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子コンポーネント間で一時的な圧力接続をなすことに関し、更に詳細には、半導体素子の実装に先行して、好適には個々の半導体素子が、半導体ウェーハから単一化される前に、半導体素子に関する試験及びエージング手順を実施するための技法に関する。

【０００２】

【従来の技術】本願は、同一出願人による１９９５年５月２６日に出願された（状況：係属中）米国特許同時係属出願第08/452,255号（以後、「親事例」と呼ぶ）の一部継続出願であり、同米国特許出願は、同一出願人による１９９４年１１月１５日に出願された（状況：係属中）米国特許同時係属出願第08/340,144号、及び１９９４年１１月１６日に出願されたその対応ＰＣＴ特許出願番号PCT/US94/13373（WO 95/14314 として１９９５年５月２６日に公告）の一部継続出願であり、それらは両方とも、同一出願による１９９３年１１月１６日に出願された（状況：係属中／認可）米国特許同時係属出願第08/152,812号の一部継続出願である。

【０００３】本願は又、同一出願人による１９９５年９月２１日に出願された（状況：係属中）米国特許同時係属出願第08/526,246号、及び同一出願人による１９９５年１０月１８日に出願された（状況：係属中）米国特許同時係属出願第08/533,584号の一部継続出願でもある。

【０００４】個々の半導体（集積回路）素子（ダイ）は通常、ホトリソグラフィ、堆積、その他の既知の技法を用いて、半導体ウェーハ上に幾つかの同一素子を作り出すことにより製造される。一般に、これらの工程は、半導体ウェーハから個々のダイを単一化（切断）する前に、完全に機能する複数の集積回路素子を作り出すことを目的とするものである。しかし、実際には、ウェーハ自体におけるある種の物理的欠陥、及びウェーハを処理する際のある種の欠陥が、ダイのうちの幾つかは「良」（完全に機能する）で、ダイのうちの幾つかは「悪」（機能しない）である原因となることは避けられない。ウェーハ上の複数のダイのうちどれが良であるかを、それらの実装の前に、好適には、それらがウェーハから単一化される前に識別できることが一般に望ましい。この目的のために、ウェーハ「試験装置」又は「プローブ装置」を有利に用いて、複数の離散的な圧力接続が、ダイ上の同様に複数の離散的な接続パッド（接着パッド）に対してなされる。このようにして、半導体ダイを、ウェーハからダイを単一化する前に、試験及び動作させることが可能となる。ウェーハ試験装置の慣用的な構成要素は、「プローブカード」であり、これに複数のプローブ要素が接続され、プローブ要素の先端が、半導体ダイの対応する接着パッドに対して圧力接続をもたらす。

【０００５】ある種の困難性が、半導体ダイにプローブを当てるいずれの技法にもつきものである。例えば、最近の集積回路は、互いに近接して（例えば、中心間５ミル）配設された何千もの接着パッドを含んでいる。更に、接着パッドのレイアウトは、ダイの周辺エッジの近くに配設される、接着パッドの単一列に限定される必要はない（例えば、米国特許第5,453,583 号を参照）。

【０００６】プローブ要素と半導体ダイの間に信頼性の良い圧力接続をもたらすには、幾つかのパラメータを問題にする必要があり、これらには、限定ではないが、位置合わせ、プローブ力、オーバードライブ、接触力、均衡した接触力、洗浄、接触抵抗、及び平坦化が含まれる。これらパラメータの一般的な議論は、「高密度プローブカード(HIGH DENSITY PROBE CARD)」と題する米国特許第4,837,622 号に見出すことができ、これを参照として本明細書に取り込むが、この特許には、プローブ要素の荒成形されたエポキシリングを受けるよう適合した中央開口を備えたユニット式印刷回路基板を含む、高密度エポキシリング・プローブカードが開示されている。

【０００７】一般に、従来技術のプローブカード・アセンブリには、プローブカードの一表面から片持ち梁として延伸する、複数のタングステン針が含まれる。タングステン針は、上記のようなエポキシリングの仲介等により、プローブカードに任意の適切な仕方で実装される。一般に、いずれの場合でも、針は、プローブカードの端子に針を接続する別個で特異なワイヤの仲介によって、プローブカードの端子に配線される。

【０００８】プローブカードは通常、円形リングとして形成され、これらは、リングの内周から延伸する（、及びプローブカードの端子に配線される）何百ものプローブ要素（針）を備える。回路モジュール、及び好適には等しい長さの導電トレース（線）が、プローブ要素の各々と関連付けられる。このリング形状レイアウトにより、特に各半導体ダイの接着パッドが、半導体ダイの２つの対向エッジに沿った２つの直線アレイ以外で配列さ

れる場合、ウェーハ上の単一化されていない複数の半導体ダイ（多数サイト）にプローブを当てることが困難になり、ある場合には不可能になる。

【０００９】ウェーハ試験装置は、代替として、中央の接触バンプ領域を有するプローブ膜を用いることもでき、これは、「超多ピン数を備えた試験下の半導体素子用の大規模突出膜(LARGE SCALE PROTRUSION MEMBRANE FOR SEMICONDUCTOR DEVICES UNDER TEST WITH VERY HIGH PIN COUNTS)」と題する、米国特許第5,422,574 号に記載されており、これを参照として本明細書に取り込む。この特許には、「試験システムは通常、一連の試験プログラムを実行及び制御するための試験コントローラと、試験の準備としてウェーハを機械的に取り扱い、位置決めするためのウェーハ分配システムと、被試験素子（ＤＵＴ）との正確な機械的接触を維持するためのプローブカードからなる。」（第１段落、４１－４６行）と記載されている。

【００１０】更なる参考文献を参照として本明細書に取り込むが、これらには、半導体素子の試験における技術状態が表わされ、米国特許第5,442,282 号（「TESTING ANDEXERCISING INDIVIDUAL UNSINGULETED DIES ON A WAFER」）、同第5,382,898 号（「HIGH DENSITY PROBE CARD FOR TESTING ELECTRICAL CIRCUITS 」）、同第5,378,982 号（「TEST PROBE FOR PANEL HAVING AN OVERLYING PROTECTIVE MEMBERADJACENT CONTACTS」）、同第5,339,027 号（「RIGID-FLEX CIRCUITS WITH RAISED FEATURES AS IC TEST PROBE 」）、同第5,180,977 号（「MEMBRANE PROBE CONTACT BUMP COMPLIANCY SYSTEM 」）、同第4,757,256 号（「HIGH DENSITY PROBE CARD 」）、同第4,161,692 号（「PROBE DEVICE FOR INTEGRATED CIRCUIT WAFERS」）、及び同第3,990,689 号（「ADJUSTABLE HOLDER ASSEMBLY FOR POSITIONING A VACUM CHUCK」）が含まれる。

【００１１】一般に、電子コンポーネント間の相互接続は、「相対的に永久な」及び「即座に取り外し可能な」相互接続という２つの広義のカテゴリーに分類できる。

【００１２】「相対的に永久な」接続の一例として、半田接合がある。一旦２つのコンポーネントが互いに半田付けされると、それらコンポーネントを分離するのに、半田除去工程を用いる必要がある。ワイヤ接着は、「相対的に永久な」接続の他の例である。

【００１３】「即座に取り外し可能な」接続の一例として、１つの電子コンポーネントの堅固なピンがあり、他の電子コンポーネントの弾力のあるソケット要素によって受容される。ソケット要素は、ピンに対して、それらの間の信頼のある電気接続を保証するのに十分な大きさの接触力（圧力）を及ぼす。

【００１４】電子コンポーネントと圧力接触をなすことを目的とした相互接続要素は、本明細書において、「スプリング」又は「ばね要素」と呼ぶ。一般に、いくらかの最小接触力が、電子コンポーネントに（例えば、電子コンポーネント上の端子に）信頼性の良い圧力接触をもたらすのに望まれる。例えば、約１５グラム（接触当たり少なくて２グラム以下、且つ多くて１５０グラム以上を含む）の接触（荷重）力が、表面上に膜で汚染され、また表面上に腐蝕、又は酸化生成物を有する、電子コンポーネントの端子に信頼性良く電気接続をなすことを保証するのに望まれる。各スプリングに必要な最小接触力には、スプリング材料の降伏強度、又はばね要素の寸法のどちらかを増大させることが必要とされる。一般的な提案として、材料の降伏強度が高くなるほど、加工（例えば、打ち抜き、曲げ等）するのが益々困難になる。そして、スプリングを更に小さく製作したいという望みによって、それらの断面を更に大きく製作することが本質的に不可能になる。

【００１５】プローブ要素は、本発明に特に関連したばね要素の１つの分類である。従来技術のプローブ要素は一般に、比較的硬質な（高降伏強度）タングステンから製造される。かかる比較的硬質な材料を電子コンポーネントの端子に実装することが所望である場合、ろう接法等の比較的「過酷な」（例えば、高温）工程が必要とされる。かかる「過酷な」工程は一般に、半導体素子等のいくつかの比較的「脆弱な」電子コンポーネントに関連して、望ましいものではない（また、実現できないことが多い）。それとは対照的に、ワイヤボンディングは、比較的「易しい」工程の一例であり、これは、ろう接法よりも、脆弱な電子コンポーネントに損傷を与えることが場合によってほとんどない。半田付けは、比較的「易しい」工程の他の例である。しかし、半田及び金は共に、比較的軟質な（低降伏強度）材料であり、これらは、ばね要素として十分には機能しない。

【００１６】スプリング接触を含む相互接続要素に関連した他の微妙な問題は、しばしば、電子コンポーネントの端子が完全には共平面でない点にある。これらの「公差」（総共平面性）を吸収するために、共に組み込まれるある機構に欠けている相互接続要素が、激しく押圧されて、電子コンポーネントの端子と一貫した圧力接触をなすことになる。

【００１７】以下の米国特許を参照として本明細書に取り込むが、これらには、電子コンポーネントに対して、面対向接続、特に圧力接続をなすことを一般的な問題として言及している。それら米国特許は、米国特許第5,386,344 号（「FLEX CIRCUIT CARD ELASTOMERIC CABLE CONNECTOR ASSEMBLY」）、同第5,336,380 号（「SPRINGBIASED TAPERED CONTACT ELEMENTS FOR ELECTRICAL CONNECTORS AND INTEGRATED CIRCUIT PACKAGES」）、同第5,317,479 号（「PLATED COMPLIANT LEAD 」）、同第5,086,337 号（「CONNECTING STRUCTURE OF ELECTRONIC PART AND ELECTRONIC DEVICE USING THE STRUCTURE 」）、同第5,067,007 号（「SEMICONDUCTOR DEVICE HAVING LE

ADS FOR MOUNTING TO A SURFACE OF A PRINTED CIRCUIT BOARD」）、同第4,989,069 号（「SEMICONDUCTOR PACKAGE HAVING LEADS THAT BREAK-AWAYFROM SUPPORTS 」）、同第4,893,172 号（「CONNECTING STRUCTUREFOR ELECTRONIC PART AND METHOD OF MANUFACTURING THE SAME」）、同第4,793,814 号（「ELECTRICAL CIRCUIT BOARD INTERCONNECT 」）、同第4,777,564 号（「LEADFRAME FOR USE WITH SURFACE MOUNTED COMPONENTS 」）、同第4,764,848 号（「SURFACE MOUNTED ARRAY STRAIN RELIEF DEVICE」）、同第4,667,219 号（「SEMICONDUCTOR CHIP INTERFACE」）、同第4,642,889 号（「COMPLIANT INTERCONNECTIONAND METHOD THEREFOR 」）、同第4,330,165 号（「PRESS-CONTACT TYPE INTERCONNECTORS」）、同第4,295,700 号（「INTERCONNECTORS 」）、同第4,067,104 号（「MEHOD OF FABRICATING AN ARRAY OF FLEXIBLE METALLIC INTERCONNECTS FORCOUPLING MICROELECTRONICS COMPONENTS 」）、同第3,795,037 号（「ELECTRICAL CONNECTOR DEVICE 」）、同第3,616,532 号（「MULTILAYER PRINTED CIRCUITELECTRICAL INTERCONNECTION DEVICE」）、及び同第3,509,270 号（「INTERCONNECTION FOR PRINTED CIRCUITS AND METHOD OF MAKING SAME」）である。

【００１８】

【発明が解決しようとする課題】本発明の１つの目的は、半導体素子を、特にそれらが半導体ウェーハ上にある間に、プローブ検査するための技法を提供することである。

【００１９】本発明の他の目的は、プローブ要素の先端の配向を、プローブカードの位置を変更することなく可能にする、半導体素子にプローブを当てるための技法を提供することである。

【００２０】本発明の他の目的は、電子コンポーネントの端子に直接実装することが可能である、改良されたばね要素（復元性のある接触構造）を提供することである。

【００２１】本発明の他の目的は、電子コンポーネントに対して圧力接触をなすのに適した相互接続要素を提供することである。

【００２２】

【課題を解決するための手段】本発明によれば、プローブカード・アセンブリには、上部表面、下部表面、及びその上部表面における複数の端子を有する、プローブカード（電子コンポーネント）と、上部表面、下部表面、その下部表面における端子から延伸する、第１の複数の復元性のある接触構造、及びその上部表面における端子から延伸する、第２の複数の復元性のある接触構造を有する、介在体（電子コンポーネント）と、上部表面、下部表面、その下部表面に配設される複数の接触パッド（端子）、及びその上部表面における端子から延伸する、第３の復元性のある接触構造（プローブ要素）を有する、間隔変換器とが含まれる。

【００２３】介在体は、プローブカードの上部表面と間隔変換器の下部表面の間に配設されて、間隔変換器の配向（平坦性）が、プローブカードの配向を変更することなく調整されることを可能にする。この間隔変換器の配向の調整をもたらすのに適した機構、及び間隔変換器の正確な配向を決定するための技法が、本明細書に開示されている。このようにして、プローブ要素の先端（遠位端）を調整して、プローブ要素の先端と、プローブ検査される半導体素子の対応する接着パッド（端子）との間に、信頼性の良い圧力接触を保証することが可能となる。

【００２４】代替として、複数の復元性のある接触構造が、介在体構成要素の代わりに、プローブカードの上部表面の端子に直接（すなわち、介在体の仲介なく）接触させるために、間隔変換器構成要素（すなわち、間隔変換器の下部表面の端子上に製造される）の下部表面に設けられる。

【００２５】一般に、間隔変換器構成要素によって、その上部表面から延伸する複数の復元性のある接触構造が、比較的微細なピッチ（間隔）で電子コンポーネントの端子（すなわち、半導体素子の接着パッド）と接触すると同時に、その下部表面における間隔変換器（すなわち、接着パッド、又は代替として、復元性のある接触構造）に、比較的粗いピッチで接続することが可能となる。

【００２６】本発明の１つの態様によれば、プローブカード・アセンブリの間隔変換器、及び介在体構成要素は、プローブカードと共に使用するのに適合した、「キット」として設けられる。任意として、間隔変換器の配向を調整するための機構を、キット内に含めることも可能である。

【００２７】本発明の１つの態様によれば、間隔変換器構成要素の上部表面から延伸する復元性のある接触構造（プローブ要素）は、「複合相互接続要素」（以下で規定される）である。間隔変換器の下部表面から延伸する復元性のある接触構造の代替の場合にも、これらは同様に「複合相互接続要素」とすることができる。

【００２８】本発明の１つの態様によれば、介在体構成要素の上部表面、及び下部表面から延伸する、復元性のある接触構造は、「複合相互接続要素」（以下で規定される）である。

【００２９】本発明の１つの態様によれば、プローブ要素（間隔変換器構成要素の上部表面から延伸する、復元性のある接触構造）は、プローブカード・アセンブリの間隔変換器構成要素の端子上に直接製造される、「複合相互接続要素」として好適に形成される。「複合」（多層）相互接続要素が、電子コンポーネントに伸長要素（「コア」）を実装し、スプリング形状を有するように成形して、結果としての複合相互接続要素の物理的（例

えば、スプリング）特性を強化し、及び／又は結果としての複合相互接続要素を電子コンポーネントに確実に締結するために、コアに保護膜生成を施すことにより製造される。介在体構成要素の復元性のある接触構造は又、複合相互接続要素として形成することもできる。

【００３０】「複合」という用語の使用は、本明細書に記載した説明を通じて、用語（例えば、２つ以上の要素から形成される）の'総称的な'意味に一致しており、例えば、ガラス、カーボン、又は樹脂その他の基材に支持される他の繊維等の材料に施されるような試みの他の分野における「複合」という用語の如何なる利用とも混同すべきではない。

【００３１】本明細書で使用する「スプリング形状」という用語は、先端に加えられる力に対して、伸長要素の端部（先端）の弾性（復元）運動を呈示する、伸長要素の事実上の任意の形状を言う。これには、１つ以上の湾曲部を有するように成形された伸長要素だけでなく、実質的に真っ直ぐな伸長要素も含まれる。

【００３２】本明細書で使用する「接触領域」、「端子」、「パッド」及び類似の用語は、相互接続要素が実装、又は接触をなす任意の電子コンポーネント上の任意の導電領域を言う。

【００３３】代替として、コアは、電子コンポーネントに実装する前に成型される。

【００３４】代替として、コアは、電子コンポーネントではない犠牲基板の一部に実装されるか、又は犠牲基板の一部である。犠牲基板は、成形後、且つ保護膜生成の前か後のどちらかで除去される。本発明の１つの態様によれば、各種の構造的特徴を有する先端は、相互接続要素の接触端に配設できる。（上述した親事例の図１１Ａ－１１Ｆも参照されたい。）本発明の１つの実施例の場合、コアは、比較的低い降伏強度を有する「軟質」材料であり、比較的高い降伏強度を有する「硬質」材料で保護膜生成される。例えば、金ワイヤ等の軟質材料が、半導体素子の接着パッドに、（例えば、ワイヤボンディングにより）取り付けられて、ニッケル及びその合金等の硬質材料で、（例えば、電気化学メッキにより）保護膜生成される。

【００３５】コアの面対向保護膜、単一及び多層保護膜、微細突出部を有する「粗い」保護膜（親事例の図５Ｃ及び５Ｄも参照されたい）、及びコアの全長、又はコア長の一部のみに延伸する保護膜が記載されている。後者の場合、コアの先端は、電子コンポーネントに接触させるために適切に露出される（親事例の図５Ｂも参照されたい）。

【００３６】一般に、本明細書に記載した説明を通じて、「メッキ」という用語は、コアに保護膜を生成するための多数の技法の一例として用いられる。本発明の範囲内にあるのは、限定ではないが、水溶液からの材料の堆積を伴う各種工程と、電解メッキと、無電解メッキと、化学気相成長法（ＣＶＤ）と、物理気相成長法（ＰＶＤ）と、液体又は固体先行物質の誘導壊変を通して、材料の堆積を生じせしめる工程と、その他を含む任意の適切な技法によって、コアに保護膜生成することができ、材料を堆積するためのこれら技法の全ては、一般に周知のところである。

【００３７】一般に、ニッケル等の金属性材料で保護膜生成するために、電気化学的工程が好適であり、特に無電解メッキが好ましい。

【００３８】本発明の他の実施例の場合、コアは、ばね要素として機能するのに本質的に適した、「硬質」材料の伸長要素であり、一端において、電子コンポーネントの端子に実装される。コア、及び端子の少なくとも隣接領域は、コアの端子への締結を強化する材料で保護膜生成される。このようにして、コアが、保護膜生成に先立って、必ずしも端子に十分実装される必要はなく、電子コンポーネントに潜在的にほとんど損傷を与えない工程を使用して、コアが、後続の保護膜生成に対して適所に「仮留め」される。これら「易しい」工程には、端子の軟質部分への硬質コアの端部の半田付け、貼り付け、及び突き刺しが含まれる。

【００３９】好適には、コアはワイヤの形態をとる。代替として、コアは平坦なタブ（導電性金属リボン）である。

【００４０】コア及び保護膜の両方に代表的な材料が開示される。

【００４１】以降では主に、一般的に非常に小さな寸法（例えば、３．０ミル以下）である比較的軟質の（低降伏強度）コアで開始することを伴う技法を説明する。半導体素子に容易に付着する金等の軟質材料は、一般に、スプリングとして機能するのに十分な復元性が無い。（かかる軟質の金属性材料は、弾性変形ではなく、主に可塑性変形を呈示する。）半導体素子に容易に付着し、また適切な復元性を持つ他の軟質材料は、非導電性であることが多く、これは、大部分の弾性材料の場合にそうである。いずれの場合でも、所望の構造的、及び電気的特性が、コアにわたって施される保護膜により、結果としての複合相互接続要素に付与できる。結果としての複合相互接続要素は、非常に小さく製作でき、更に、適切な接触力も呈示し得る。更に、複数のかかる複合相互接続要素は、それらが、隣接する複合相互接続要素に対する距離（隣接する相互接続要素間の距離は、「ピッチ」と呼ばれる）よりもかなり大きな長さ（例えば、１００ミル）を有するとしても、微細ピッチ（例えば、１０ミル）で配列できる。

【００４２】本発明の範囲内にあるのは、複合相互接続要素を、例えば、２５ミクロン（μｍ）以下の程度の断面寸法を有する、コネクタ及びソケット用の「超小型スプリング」のような、超小型スケールで製造可能なことである。ミルではなくミクロンで測定される寸法を有す

る信頼性の良い相互接続を製造できるこの能力は、現存の相互接続技法、及び将来のエリアアレイ技法という発展する要求に真っ向から対処する。

【００４３】本発明の複合相互接続要素は、優れた電気的特性を呈示し、これには、導電率、半田付け可能性、及び低い接触抵抗が含まれる。多くの場合、加えられる接触力に応答した相互接続要素の偏向は、結果として「拭い」接触となり、これは、信頼性の良い接触をなすのを保証するのに役立つ。

【００４４】本発明の追加の利点は、本発明の相互接続要素となされる接続が、容易に取り外し可能である点にある。電子コンポーネントの端子に相互接続をもたらす半田付けは、任意であるが、一般にシステムレベルでは好ましくない。

【００４５】本発明の１つの態様によれば、制御されるインピーダンスを有する相互接続要素を製作するための方法が記載される。これらの技法には、一般に、誘電体材料（絶縁層）で導電コア、又は複合相互接続要素全体を被覆し（例えば、電気泳動的に）、導電材料の外部層で誘電体材料に保護膜生成することが伴う。外部の導電材料層を接地することにより、結果としての相互接続要素は効果的に遮蔽することができ、そのインピーダンスは容易に制御可能となる。（親事例の図１０Ｋも参照されたい。）本発明の１つの態様によれば、相互接続要素は、電子コンポーネントへの後での取り付けのために、予め製造することができる。この目的を達成するための各種の技法が、本明細書に記載されている。本書類では特定的に保護されていないが、複数の個々の相互接続要素の基板への実装、又は代替として、エラストマーにおいて、又は支持基板上で複数の個々の相互接続要素の懸架を扱う機械を製造することも比較的簡単明瞭であると考えられる。

【００４６】明確に理解されたいのは、本発明の複合相互接続要素は、その導電特性を強化する、又はその腐食耐性を強化するために被覆されていた、従来技術の相互接続要素とは劇的に異なるということである。

【００４７】本発明の保護膜は、電子コンポーネントの端子への相互接続要素の締結を実質的に強化する、及び／又は結果としての複合相互接続要素に、所望の復元特性を付与することを特定的に意図するものである。応力（接触力）は、応力を吸収することを特定的に意図する、相互接続要素の部分に向けられる。

【００４８】また認識されたいのは、本発明は、スプリング構造を製作するための本質的に新規な技法を提供するということである。一般に、結果としてのスプリングの動作構造は、曲げ及び成形の生成物ではなく、メッキの生成物である。これによって、スプリング形状を確立する広範な材料、及びコアの「足場」を電子コンポーネントに取り付けるための各種の「易しい」工程の利用に対して扉が開かれる。保護膜は、コアの「足場」にわたった「超構造」として機能し、その両方が、土木工学の分野においてそれらの原点を有することを意味する。

【００４９】本発明の特異な利点は、プローブ要素が、ろう接、又は半田付け等の追加の材料を必要とせず、プローブカード・アセンブリの間隔変換器の基質構成要素の端子上に直接製造できる点にある。

【００５０】本発明の１つの態様によれば、復元性のある接触構造のいずれもが、少なくとも２つの複合相互接続要素として形成される。

【００５１】本発明の他の目的、特徴、及び利点は、以下の発明の詳細な説明に鑑みて明らかになるであろう。

【００５２】

【発明の実施の形態】参照は、本発明の好適な実施例に対して詳細になされ、その例は、添付図面に示されている。これらの好適な実施例に関連して本発明を説明するが、理解されたいのは、本発明の精神、及び範囲をこれら特定の実施例に限定することを意図しない、ということである。

【００５３】本特許出願は、プローブカードアセンブリ、その構成要素、及びそれらを用いる方法を目指すものである。以下の詳細な説明から明らかとなるが、電子コンポーネントの端子に対して圧力接続をもたらすために、復元性のある接触構造を用いることが本質的である。好適には、復元性のある接触構造は、「複合相互接続要素」として実施され、これは例えば、１９９５年５月２６日に出願され、参照として本明細書に取り込む、上述した米国特許出願第08/452,255号（「親事例」）の開示に記載されている。本特許出願は、図１－５、及び図６－14の記載において、親出願に開示される技法の幾つかを要約するものである。

【００５４】本発明の重要な態様は、（１）結果としての複合相互接続要素の機械的性質を確立し、（２）相互接続要素が電子コンポーネントの１つの端子に実装される場合に、その端子に相互接続要素を確実に締結するために、「複合」相互接続要素が、コア（電子コンポーネントの端子に実装される）で開始し、次いで、適切な材料でコアに保護膜を生成することにより形成できる点にある。このようにして、弾性変形可能な形状へと容易に成形されて、電子コンポーネントの最も脆弱な部分にさえも容易に取り付けられる、軟質材料のコアで開始することにより、復元性のある相互接続要素（ばね要素）が製造できる。硬質材料からばね要素を形成し、容易には明白でなく、論証可能に直感的でない従来技術を鑑みると、その軟質材料は、ばね要素の基底部を形成可能である。かかる「複合」相互接続要素は、一般に、本発明の実施例に用いるのに、好適な形態の復元性のある接触構造である。

【００５５】図１、２、３及び４は、本発明に従った、複合相互接続要素用の各種の形状を一般的に示す。

【００５６】以降では主に、復元性を呈示する複合相互

接続要素を説明する。しかし理解されたいのは、復元性のない複合相互接続要素も本発明の範囲内に入るということである。

【００５７】更に、以降では主に、硬質（弾性）材料により保護膜生成される、軟質（容易に成形されて、使い勝手の良い工程により、電子コンポーネントに固定しやすい）コアを有する、複合相互接続要素を説明する。しかし、コアを硬質材料とし得ることも本発明の範囲内にあり、保護膜は、主に、電子コンポーネントに相互接続要素を確実に締結するように機能する。

【００５８】図１において、電気的な相互接続要素１１０には、「軟質」材料（例えば、４０，０００ｐｓｉよりも少ない降伏強度を有する材料）のコア１１２と、「硬質」材料（例えば、８０，０００ｐｓｉよりも大きな降伏強度を有する材料）のシェル（保護膜）１１４とが含まれる。コア１１２は、概ね真っ直ぐな片持ち梁として成形（構成）される伸長要素であり、０．０００５から０．００３０インチ（０．００１インチ＝１ミル≒２５ミクロン（μｍ））の直径を有するワイヤとすることができる。シェル１１４は、既に成形されたコア１１２にわたって、適切なメッキ工程（例えば、電気化学メッキ）等の任意の適切な工程により施される。

【００５９】図１は、本発明の相互接続要素に対して恐らく最も簡単な形状と思われるスプリング形状、すなわち、その先端１１０ｂにおいて加えられる力「Ｆ」に対して、ある角度で配向された真っ直ぐな片持ち梁を示す。かかる力が、相互接続要素が圧力接触している電子コンポーネントの端子により加えられる場合、先端の下方への（図で見て）偏向により、明らかに結果として、先端が端子を横切って移動する、すなわち「拭い」運動となる。かかる拭い接触により、信頼性の良い接触が、相互接続要素と電子コンポーネントの接触端子との間でなされることが保証される。

【００６０】その「硬質性」のおかげで、またその厚さ（０．０００２５から０．００５００インチ）を制御することにより、シェル１１４は、相互接続要素１１０全体に対して、所望の復元性を付与する。このようにして、電子コンポーネント（不図示）間の復元性のある相互接続を、相互接続要素１１０の２つの端部１１０ａと１１０ｂの間にもたらすことができる。（図１において、参照番号１１０ａは、相互接続要素１１０の一端を示し、端部１１０Ｂに対向した実際の端部は示されていない。）電子コンポーネントの端子に接触する際に、相互接続要素１１０は、「Ｆ」で表記される矢印で示されるような、接触力（圧力）を受けることになる。

【００６１】相互接続要素（例えば、１１０）は、加えられる接触力に応答して偏向することになるが、該偏向（復元性）は、相互接続要素の全体形状によって部分的に、（コアの降伏強度に対して）保護膜材料の優勢な（より大きな）降伏強度により部分的に、また、保護膜材料の厚さにより部分的に決定される。

【００６２】本明細書で用いる「片持ち式」及び「片持ち梁」という用語は、伸長構造（例えば、保護膜付きコア１１２）が、一端に実装（固定）されて、他端は、通常、伸長要素の長手方向軸に対して概ね横方向に作用する力に応答して、自由に移動する。これらの用語の使用により、伝達又は暗示を意図する他の特定的な、又は限定的な意味は何もない。

【００６３】図２において、電気的な相互接続要素１２０には、同様に、軟質コア１２２（１１２に匹敵）と、硬質シェル１２４（１１４に匹敵）とが含まれる。この例の場合、コア１２２は、２つの湾曲部を有するように成形され、従って、Ｓ字形状と見なされる。図１の例のように、このようにして、電子コンポーネント（不図示）間の復元性のある相互接続を、相互接続要素１２０の２つの端部１２０ａと１２０ｂの間にもたらすことができる。（図２において、参照番号１２０ａは、相互接続要素１２０の一端部を示し、端部１２０ｂに対向した実際の端部は示されていない。）電子コンポーネントの端子に接触する際に、相互接続要素１２０は、「Ｆ」で表記される矢印で示されるような、接触力（圧力）を受けることになる。

【００６４】図３において、電気的な相互接続要素１３０には、同様に、軟質コア１３２（１１２に匹敵）と、硬質シェル１３４（１１４に匹敵）とが含まれる。この例の場合、コア１３２は、１つの湾曲部を有するように成形され、Ｕ字形状と見なすことができる。図１の例のように、このようにして、電子コンポーネント（不図示）間の復元性のある相互接続を、相互接続要素１３０の２つの端部１３０ａと１３０ｂの間にもたらすことができる。（図３において、参照番号１３０ａは、相互接続要素１３０の一端部を示し、端部１３０ｂに対向した実際の端部は示されていない。）電子コンポーネントの端子に接触する際に、相互接続要素１３０は、「Ｆ」で表記される矢印で示されるような、接触力（圧力）を受けられることになる。代替として、相互接続要素１３０を使用して、「Ｆ’」で表記される矢印で示されるように、その端部１３０ｂ以外で接触をなすこともできる。

【００６５】図４は、軟質コア１４２と硬質シェル１４４を有する、復元性のある倉庫接続要素１４０の他の実施例を示す。この例の場合、相互接続要素１４０は、本質的に簡単な片持ち式（図１に匹敵）であり、湾曲した先端１４０ｂは、その長手方向軸に対して横方向に作用する接触力「Ｆ」を受ける。

【００６６】図５は、軟質コア１５２と硬質シェル１５４を有する、復元性のある相互接続要素１５０の他の実施例を示す。この例の場合、相互接続要素１５０は、概ね「Ｃ字形状」であり、好適には僅かに湾曲した先端を備え、「Ｆ」で表記される矢印で示されるように、圧力接触をなすのに適している。

【００６７】理解されたいのは、軟質コアは、任意の弾性変形可能な形状、換言すると、復元性のある相互接続要素に、その先端に加えられる力に応答して弾性的に偏向せしめる形状へと、容易に形成することができるということである。例えば、コアは、慣用的なコイル形状に形成することもできる。しかし、コイル形状は、相互接続要素の全長、及びそれに関連したインダクタンス（その他）、また高周波（速度）で動作する回路へのインダクタンスの悪影響に起因して好ましくない。

【００６８】シェル、又は多層シェル（以下で説明する）の少なくとも１つの層の材料は、コアの材料よりも大幅に高い降伏強度を有する。従って、シェルは、結果としての相互接続構造の機械的特性（例えば、弾性）を確立する際にコアの影を薄くする。シェル対コアの降伏強度の比率は、少なくとも２：１が好適であり、少なくとも３：１及び少なくとも５：１も含み、１０：１程度に高くすることもできる。また明らかなのは、シェル、又は多層シェルの少なくとも外部層は、導電性にすべきであり、シェルがコアの端部を覆う場合には顕著である。（しかし、親事例には、コアの端部が露出される実施例が記載されており、その場合には、コアは導電性でなければならない。）学術的な観点から、結果としての複合相互接続要素のばね作用（スプリング形状）部分に、硬質材料で保護膜生成することが唯一必要である。この観点から、コアの２つの端部の両方に保護膜生成することは一般に本質的でない。しかし、実際問題としては、コア全体に保護膜生成することが好ましい。電子コンポーネントに締結（取り付け）られるコアの一端に保護膜生成する特定の理由、及びそれで生じる利点を、以下で更に詳細に論じる。

【００６９】コア（１１２、１２２、１３２、１４２）に適した材料には、限定でないが、金、アルミニウム、銅、及びそれらの合金が含まれる。これらの材料は通常、所望の物理的性質を得るために、少量の他の材料で合金化されるが、それらは例えば、ベリリウム、カドミウム、シリコン、マグネシウム、その他である。銀、パラジウム、プラチナ、プラチナ群の元素の金属等の金属又は合金を用いることも可能である。鉛、スズ、インジウム、ビスマス、カドミウム、アンチモン、及びそれらの合金から構成される半田が使用可能である。

【００７０】電子コンポーネントの端子へのコア（ワイヤ）の一端の面対向取り付け（以下で更に詳細に論じる）は、一般に、（温度、圧力、及び／又は超音波エネルギーを用いて、ボンディングをもたらす）ボンディングしやすい任意の材料（例えば、金）のワイヤであり、これは、本発明を実施するのに適している。非金属材料を含む、保護膜生成（例えば、メッキ）しやすい任意の材料が、コアに使用できることも本発明の範囲内である。シェル（１１４、１２４、１３４、１４４）に適した材料には、（多層シェルの個々の層に関して、以下で論じるように）限定ではないが、ニッケル及びその合金と、銅、コバルト、鉄及びそれらの合金と、両方とも卓越した電流搬送能力、及び良好な接触抵抗特性を呈示する、金（特に硬質の金）及び銀と、プラチナ群の元素と、貴金属と、半貴金属及びそれらの合金、特にプラチナ群の元素及びそれらの合金と、タングステンと、モリブデンが含まれる。半田状の仕上げが所望の場合には、スズ、鉛、ビスマス、インジウム、及びそれらの合金を用いることもできる。

【００７１】これらの被覆材料を、上記に記載した各種のコア材料にわたって施すために選択される技法は、無論のこと、用途に合わせて変化する。電解メッキ、及び無電解メッキは一般に好適な技法である。しかし、一般には、金のコアにわたってメッキを施すことは、直感的ではない。本発明の１つの態様によれば、金のコアにわたってニッケルのシェルをメッキする（特に、無電解メッキする）場合、メッキ開始を容易にするために、まず、金のワイヤステムにわたって薄い銅の開始層を施すことが望ましい。

【００７２】図１－５に示すような例示的な相互接続要素は、約０．００１インチのコア径と、０．００１インチのシェル厚を有し、従って、相互接続要素は、約０．００３インチの全体径（すなわち、コア径足す２倍のシェル厚）を有する。一般に、シェルのこの厚さは、コアの厚さ（例えば、直径）の０．２－５．０（１／５から５）倍程度となる。

【００７３】複合相互接続要素に関する幾つかの例示的なパラメータは、以下のようになる。

【００７４】（ａ）１．５ミルの直径を有する金のワイヤコアが、４０ミルの全長、及び９ミル半径の略Ｃ字状湾曲（図５に匹敵）を有するように成形され、０．７５ミルのニッケルでメッキされ（全体径＝１．５＋２×０．７５＝３ミル）て、任意として金の５０マイクロインチの最終保護膜を受容する。結果としての複合相互接続要素は、約３－５グラム／ミルのばね定数（ｋ）を呈示する。使用時に、３－５ミルの偏向は、結果として９－２５グラムの接触力となる。この例は、介挿物用のばね要素に関連して有用である。

【００７５】（ｂ）１．０ミルの直径を有する金のワイヤコアが、３５ミルの全長を有するように成形され、１．２５ミルのニッケルでメッキされ（全体径＝１．０＋２×１．２５＝３．５ミル）て、任意として金の５０マイクロインチの最終保護膜を受容する。結果としての複合相互接続要素は、約３グラム／ミルのばね定数（ｋ）を呈示して、プローブ用のばね要素に関連して有用である。

【００７６】（ｃ）１．５ミルの直径を有する金のワイヤコアが、２０ミルの全長、及び約５ミルの半径の略Ｓ字状湾曲を有するように成形され、０．７５ミルのニッケル又は銅でメッキされる（全体径＝１．５＋２×０．

７５＝３ミル）。結果としての複合相互接続要素は、約２－３グラム／ミルのばね定数（ｋ）を呈示して、半導体素子上に実装するためのばね要素に関連して有用である。

【００７７】以下で更に詳細に示すように、コアは、丸い断面を有する必要はなく、むしろシートから延伸する平坦なタブ（矩形断面を有する）とすることもできる。理解されたいのは、本明細書で用いる「タブ」という用語は、「ＴＡＢ」（テープ自動化ボンディング）と混同すべきでない、ということである。

【００７８】多層シェル

図６は、端子２１４が設けられる電子コンポーネント２１２に実装された、相互接続要素２１０の１つの実施例２００を示す。この例の場合、軟質（例えば、金）ワイヤコア２１６が、一端において端子２１４にボンディングされ（取り付けられ）、端子から延伸してスプリング形状を有するように構成され（図２に示す形状に匹敵）て、自由端２１６ｂを有するように切断される。このようにワイヤのボンディング、成形、及び切断は、ワイヤボンディング装置を用いて達成される。コアの端部２１６ａにおける接着剤は、端子２１４の露出表面の比較的小さい部分しか覆わない。

【００７９】シェル（保護膜）が、ワイヤコア２１６にわたって配設され、この例の場合、多層化として示され、内層２１８と外層２２０を有し、その両方の層はメッキ工程により適切に施される。多層シェルの１つ以上の層が、硬質材料（ニッケル及びその合金等の）から形成されて、所望の復元性が、相互接続要素２１０に付与される。例えば、外層２２０は、硬質材料とすることができ、内層は、コア材料２１６上に硬質材料２２０をメッキする際に、緩衝又は障壁層として（あるいは、活性層、接着材層として）機能する材料とすることができる。代替として、内層２１８を硬質材料とし、外層２２０を、導電率及び半田付け可能性を含めた優れた電気的特性を呈示する材料（軟質の金等）とすることもできる。半田又はろう接型式の接触が所望の場合、相互接続要素の外層は、それぞれ、鉛－スズ半田又は金－スズろう接材料とすることができる。

【００８０】端子への締結

図６は、総括的に、本発明の他の重要な特徴、すなわち復元性のある相互接続要素が、電子コンポーネント上の端子に確実に締結できることを示す。相互接続要素の取付端２１０ａは、相互接続要素の自由端２１０ｂに加えられる圧縮力（矢印「Ｆ」）の結果として、大幅な機械的応力を受ける。

【００８１】図６に示すように、保護膜（２１８、２２０）は、コア２１６だけでなく、連続して（中断なしに）コア２１６に隣接する端子２１４の残り（すなわち、接着剤２１６ａ以外）の露出表面全体も覆う。これによって、相互接続要素２１０が、端子に確実且つ信頼性良く締結され、保護膜材料が、端子への結果としての相互接続要素の締結に対して、実質的に（例えば、５０％よりも大きく）寄与する。一般に、必要なのは、保護膜材料が、コアに隣接する端子の少なくとも一部を覆うことだけである。しかし、保護膜材料は、端子の残りの表面全体を覆うことが一般に好ましい。好適には、シェルの各層は金属性である。

【００８２】一般的な提案として、コアが端子に取付（接着）される比較的小さい領域は、結果としての複合相互接続要素に課せられる接触力（「Ｆ」）から生じる応力を吸収するのにあまり適さない。シェルが、端子の露出表面全体（端子へのコア端２１６ａの取付をなす比較的小さい領域以外の）を覆うおかげで、相互接続構造全体が、端子に確実に締結される。保護膜の接着強度、及び接触力に反作用する能力は、コア端（２１６ａ）自体のそれよりはるかに高い。

【００８３】本明細書で用いる「電子コンポーネント」（例えば、２１２）という用語には、限定ではないが、相互接続及び介挿基板と、シリコン（Ｓｉ）又はヒ化ガリウム（ＧａＡｓ）等の任意の適切な半導体材料製の半導体ウェーハ及びダイと、生成相互接続ソケットと、試験ソケットと、親事例に記載されているような犠牲部材、要素及び基板と、セラミック及びプラスチックパッケージ、及びチップキャリアを含む半導体パッケージと、コネクタとが含まれる。

【００８４】本発明の相互接続要素は、特に、以下のものとして用いるのに十分適している。すなわち、

・半導体パッケージを有する必要がなく、シリコンダイに直接実装される相互接続要素と、

・電子コンポーネントを試験するために、基板（以下で更に詳細に説明する）からプローブとして延伸する相互接続要素と、

・介挿物（以下で更に詳細に論じる）の相互接続要素である。

【００８５】本発明の相互接続要素は、それが、硬質材料の付随の通常貧弱なボンディング特性によって制限されることなく、硬質材料の機械的特性（例えば、高い降伏強度）の恩恵を受ける点で類を見ない。これは、親事例に詳しく述べられているように、シェル（保護膜）が、コアの「足場」にわたって「超構造」として機能するという事実により大いに可能になる。ここで、それら２つの用語は、土木工学の環境から借用したものである。これは、メッキが保護（例えば、耐腐食）被覆として用いられ、また、相互接続構造に対して所望の機械的特性を付与するのが一般に不可能である、従来技術のメッキ化相互接続要素とは非常に異なる。また、これは、電気的な相互接続部に施されるベンゾトリアゾール（ＢＴＡ）等の、任意の非金属性の耐腐食被覆とはある種著しく対照的である。

【００８６】本発明の多数の利点の中には、複数の自立

相互接続構造が、基板の上の共通の高さに対して、減結合コンデンサを有するＰＣＢ等のその異なるレベルから、基板上に容易に形成されるので、それらの自由端は互いに共平面にあるという利点がある。更に、本発明に従って形成される相互接続要素の電気的、及び機械的（例えば、可塑及び弾性）特性が共に、特定の用途に対して容易に合わせられる。例えば、所与の用途において望ましいのは、相互接続要素が、可塑及び弾性変形を呈示することである。（可塑変形が望ましいのは、相互接続要素により相互接続されるコンポーネントにおいて、総非平面性を吸収するためである。）弾性的な挙動が所望である場合、相互接続要素が、最小閾値量の接触力を発生して、信頼性の良い接触をもたらすことが必要である。また利点は、接触表面上に汚染膜が偶発的に存在することに起因して、相互接続要素の先端が、電子コンポーネントの端子と拭い接触をなす点にもある。

【００８７】本明細書で用い、接触構造に適用される「復元性のある」という用語は、加えられた荷重（接触力）に応答して、主に弾性的な挙動を呈示する接触構造（相互接続要素）を意味し、また、「従順な」という用語は、加えられた荷重（接触力）に応答して、弾性的及び可塑的な挙動の両方を呈示する接触構造（相互接続要素）を意味する。本明細書で用いるような、「従順な」接触構造は、「復元性のある」接触構造である。本発明の複合相互接続要素は、従順な、又は復元性のある接触構造のどちらかの特別な場合である。

【００８８】多数の特徴は、親事例に詳細に述べられており、限定ではないが、犠牲基板上に相互接続要素を製造するステップと、電子コンポーネントに複数の相互接続要素を一括転写するステップと、好適には粗い表面仕上げである接触先端を相互接続要素に設けるステップと、一時的、次いで永久的な接続を電子コンポーネントになすために、電子コンポーネント上に相互接続要素を使用するステップと、相互接続要素を、それらの対向端での間隔とは異なる一端での間隔を有するように配列するステップと、相互接続要素を製造するステップと同一工程のステップで、ばねクリップ、及び位置合わせピンを製造するステップと、接続されたコンポーネント間での熱膨張による差異を吸収するように、相互接続要素を使用するステップと、個別の半導体パッケージ（ＳＩＭＭ等の）の必要性を廃除するステップと、任意として、復元性のある相互接続要素（復元性のある接触構造）を半田付けするステップとを含む。

【００８９】制御されたインピーダンス

図７は、多層を有する複合相互接続要素２２０を示す。相互接続要素２２０の最内部（内部の細長い導電要素）２２２は、上記したように、未被覆コアか、又は既に保護膜生成されているコアのいずれかである。最内部２２２の先端２２２ｂは、適切なマスキング材料（不図示）でマスクされる。誘電体層２２４が、電気泳動工程等により最内部２２２にわたって施される。導電材料の外層２２６が、誘電体層２２４にわたって施される。

【００９０】使用時に、外層２２６を電気的に接地することにより、結果として、相互接続要素が、制御されたインピーダンスを有することになる。誘電体層２２４用の例示的な材料は、高分子材料であり、任意の適切な仕方で、且つ任意の適切な厚さ（例えば、０．１－３．０ミル）に施される。

【００９１】外層２２６は多層とすることができる。例えば、最内部２２２が未被覆のコアである例では、相互接続要素全体が復元性を呈示することが所望である場合、外層２２６のうち少なくとも１つの層は、ばね材料である。

【００９２】ピッチ変更

図８は、複数（図示では多くのうち６個）の相互接続要素２５１…２５６が、プローブカード挿入（慣用的な仕方でプローブカードに実装される副アセンブリ）等の電子コンポーネント２６０の表面上に実装される実施例２５０を示す。プローブカード挿入の端子及び導電トレースは、図示の明瞭化のために、この図面から省略されている。相互接続要素２５１…２５６の取付端は、０．０５－０．１０インチといった第１のピッチ（間隔）で始まる。相互接続要素２５１…２５６は、それらの自由端（先端）が０．００５－０．０１０インチといった第２の微細なピッチとなるように、成形及び／又は配向される。あるピッチから別のピッチへと相互接続をなす相互接続アセンブリは、通常、「間隔変換器」と呼ばれる。

【００９３】図示のように、相互接続要素の先端２５１ｂ…２５６ｂは、２つの平行な列状に配列されるが、これは例えば、接着パッド（接点）の２つの平行な列を有する半導体素子に接触させる（試験及び／又はエージング時に）ためである。相互接続要素は、他の先端パターを有するように配列できるが、これは、アレイ等の他の接点パターンを有する電子コンポーネントに接触させるためである。

【００９４】一般に、本明細書に開示される実施例を通じて、１つの相互接続要素しか示さないが、本発明は、複数の相互接続要素を製造して、周辺パターン又は矩形アレイパターンといった、互いに規定の空間関係で複数の相互接続要素を配列することにも適用可能である。

【００９５】犠牲基板の使用

電子コンポーネントの端子への直接的な相互接続要素の実装を以上に説明した。総括的に言うと、本発明の相互接続要素は、犠牲基板を含む任意の適切な基板の任意の適切な表面に製造、又は実装可能である。

【００９６】親事例に注目されたいが、これには、例えば電子コンポーネントへの後続の実装のための別個、且つ特異な構造として、複数の相互接続構造（例えば、復元性のある接触構造）を製造する図１１Ａ－１１Ｆに関しての記載、及び犠牲基板（キャリア）に複数の相互接

続要素を実装し、次いで電子コンポーネントにひとまとめで複数の相互接続要素を転写する図１２Ａ－１２Ｃに関しての記載がある。

【００９７】図９－11は、犠牲基板を用いて、先端構造を実施した複数の相互接続要素を製造するための技法を示す。

【００９８】図９は、技法２５０の第１のステップを示し、マスキング材料２５２のパターン化層が、犠牲基板２５４の表面上に施される。犠牲基板２５４は、例として、薄い（１－１０ミル）銅又はアルミニウム箔とすることができ、マスキング材料２５２は、共通のホトレジストとなる。マスキング層２５２は、相互接続要素の製造を所望する位置２５６ａ、２５６ｂ、２５６ｃにおいて、複数（図示では多くのうち３個）の開口を有するようにパターン化される。位置２５６ａ、２５６ｂ、及び２５６ｃは、この意味で、電子コンポーネントの端子に匹敵する。位置２５６ａ、２５６ｂ、及び２５６ｃは、この段階で好適に処理されて、粗い又は特徴的な表面模様を有する。図示のように、これは、位置２５６ａ、２５６ｂ、及び２５６ｃにおいて、箔２５４に窪みを形成する型押し治具２５７で機械的に達成される。代替として、３つの位置での箔の表面を、表面模様を有するように化学的にエッチングすることも可能である。この一般的な目的をもたらすのに適した任意の技法は、本発明の範囲内にあり、例えばサンドブラスティング、ピーニングその他である。

【００９９】次に、複数（図示では多くのうち１つ）の導電性先端構造２５８が、図10に示すように、各位置（例えば、２５６ｂ）に形成される。これは、電解メッキ等の任意の適切な技法を用いて達成され、多層の材料を有する先端構造を含む。例えば、先端構造２５８は、犠牲基板上に施されるニッケルの薄い（例えば、１０－１００マイクロインチ）障壁層、続いて軟質の金の薄い（例えば、１０マイクロインチ）、続いて硬質の金の薄い（例えば、２０マイクロインチ）層、続いてニッケルの比較的厚い（例えば、２００マイクロインチ）層、軟質の金の最終の薄い（例えば、１００マイクロインチ）層を有する。一般に、ニッケルの第１の薄い障壁層は、後続の金の層が、基板２５４の材料（例えば、アルミニウム、銅）によって「腐敗」されるのを防止するために設けられ、ニッケルの比較的厚い層は、先端構造に強度を与えるためであり、軟質の金の最終の薄い層は、容易に接着される表面を与える。本発明は、先端構造を犠牲基板上に形成する方法の如何なる特定例にも限定されない。というのは、これらの特定例は、用途に応じて必然的に変化するためである。

【０１００】図10に示すように、相互接続要素用の複数（図示では多くのうち１つ）のコア２６０が、例えば、上記した電子コンポーネントの端子に軟質のワイヤコアをボンディングする技法のいずれかによって、先端構造２５８上に形成される。コア２６０は次に、上記の仕方で好適には硬質材料２６２で保護膜生成され、マスキング材料２５２が次いで除去され、結果として、図11に示すように、犠牲基板の表面に実装される複数（図示では多くのうち３つ）の自立相互接続要素２６４となる。

【０１０１】図６に関連して説明した、端子（２１４）の少なくとも隣接した領域を覆う保護膜材料と同様にして、保護膜材料２６２は、それらの対応する先端構造２５８にコア２６０を確実に締結し、所望の場合、結果としての相互接続要素２６２に復元特性を付与する。親事例で注記したように、犠牲基板に実装される複数の相互接続要素は、電子コンポーネントの端子に一括転写される。代替として、２つの広範に分岐した経路をとることもできる。

【０１０２】シリコンウェーハを犠牲基板として使用でき、その上に先端構造が製造されること、及びそのように製造された先端構造が、電子コンポーネントに既に実装されている復元性のある接触構造に連結（例えば、半田付け、ろう接）できることも、本発明の範囲内である。

【０１０３】図12に示すように、犠牲基板２５４は、選択性化学エッチング等の任意の適切な工程により簡単に除去される。ほとんどの選択性化学エッチングは、他方の材料よりもかなり大きな比率で一方の材料をエッチングし、また、他方の材料は、その工程で僅かしかエッチングされないので、この現象を有利に用いて、犠牲基板の除去と同時に、先端構造におけるニッケルの薄い障壁層が除去される。しかし、必要ならば、薄いニッケル障壁層は、後続のエッチングステップでも除去可能である。これによって、結果として、複数（図示では多くのうち３つ）の個々に離散し特異な相互接続要素２６４となり、これは点線２６６で示され、電子コンポーネント上の端子に（半田付け又はろう接等により）後で装着される。

【０１０４】また、言及すべきは、保護膜材料が、犠牲基板及び／又は薄い障壁層を除去する工程で、僅かに薄くされるという点である。しかし、これが生じないほうが好ましい。

【０１０５】保護膜の薄小化を防止するには、金の薄い層、又は例えば、約２０マイクロインチの硬質の金にわたって施される約１０マイクロインチの軟質の金が、保護膜材料２６２にわたって最終層として施されることが好ましい。かかる金の外層は、主に、その優れた導電率、接触抵抗、及び半田付け可能性を意図するものであり、障壁層及び犠牲基板の除去に用いることを意図した、ほとんどのエッチング溶液に対して、一般に不浸透性が高い。

【０１０６】代替として、図13に示すように、犠牲基板２５４の除去に先行して、複数（図示では多くのうち３つ）の相互接続要素２６４が、内部に複数の穴を有する

薄いプレート等の任意の適切な支持構造２６６によって、互いの所望の空間関係で「固定」され、それに基づき犠牲基板が除去される。支持構造２６６は、誘電体材料、又は誘電体材料で保護膜生成される導電材料とすることができる。シリコンウェーハ又は印刷回路基板等の電子コンポーネントに、複数の相互接続要素を装着するステップといった、更なる処理ステップが次に進行する。加えて、幾つかの用途において、相互接続要素２６４の先端（先端構造に対向した）が移動しないように安定化することが望ましく、これは特に、そこに接触力が加えられる場合である。この目的のために、また望ましいのは、誘電体材料から形成されたメッシュといった、複数の穴を有する適切なシート２６８で、相互接続要素の先端の移動に制約を与えることである。

【０１０７】上記の技法２５０の特異な利点は、先端構造（２５８）が、事実上任意の所望の材料から形成されて、事実上任意の所望の模様を有する点にある。上述したように、金は、導電性、低い接触抵抗、半田付け可能性、及び腐蝕耐性という卓越した電気的特性を呈示する貴金属の一例である。金は又可鍛性であるので、本明細書に記載の相互接続要素、特に本明細書に記載の復元性のある相互接続要素のいずれかにわたって施される、最終の保護膜とするのに極めて十分適している。他の貴金属も同様に望ましい特性を呈示する。しかし、かかる卓越した電気的特性を呈示する、ロジウム等の幾つかの材料は、一般に、相互接続要素全体に保護膜生成するのに適切でない。例えば、ロジウムは、著しく脆く、復元性のある相互接続要素上の最終保護膜として十分には機能しない。これに関して、技法２５０に代表される技法は、この制限を容易に克服する。例えば、多層先端構造（２５８を参照）の第１の層は、（上記のように金ではなく）ロジウムとすることができ、それにより、結果としての相互接続要素のいかなる機械的挙動にも何の影響を与えることなく、電子コンポーネントに接触させるために、その優れた電気的特性を引き出す。

【０１０８】図14は、相互接続要素を製造するための代替実施例２７０を示す。この実施例の場合、マスキング材料２７２が、犠牲基板２７４の表面に施されて、図９に関して上記した技法と同様にして、複数（図示では多くのうち１つ）の開口２７６を有するようにパターン化される。開口２７６は、相互接続要素が、自立構造として製造される領域を規定する。（本明細書に記載の説明を通じて用いる、相互接続要素が「自立」であるのは、その一端が、電子コンポーネントの端子、又は犠牲基板のある領域にボンディングされ、また、その他端が、電子コンポーネント、又は犠牲基板にボンディングされない場合である。）開口内の領域は、犠牲基板２７４の表面内に延伸する単一の窪みで２７８示されるように、１つ以上の窪みを有するように、任意の適切な仕方で模様加工される。

【０１０９】コア（ワイヤステム）２８０が、開口２７６内の犠牲基板の表面にボンディングされて、任意の適切な形状を有する。この図示の場合、例示の明瞭化のために、１つの相互接続要素の一端しか示されていない。他端（不図示）は、電子コンポーネントに取り付けられる。ここで容易に見られるのは、コア２８０が、先端構造２５８ではなく、犠牲基板２７４に直接ボンディングされるという点で、技法２７０が上述した技法２５０とは異なるということである。例として、金ワイヤコア（２８０）が、慣用的なワイヤボンディング技法を用いて、アルミニウム基板（２７４）の表面に容易にボンディングされる。

【０１１０】工程（２７０）の次のステップでは、金の層２８２が、コア２８０にわたって、また、窪み２７８内を含む、開口２７６内の基板２７４の露出領域上に施される（例えば、メッキにより）。この層２８２の主な目的は、結果としての相互接続要素の端部に、接触表面を形成することである（すなわち、犠牲基板が除去されると）。

【０１１１】次に、ニッケル等の比較的硬質な材料の層２８４が、層２８２にわたって施される。上述したように、この層２８４の１つの主な目的は、結果としての複合相互接続要素に所望の機械的特性（例えば、復元性）を付与することである。この実施例において、層２８４の他の主な目的は、結果としての相互接続要素の低い方の（図示のように）端部に製造される接触表面の耐久性を強化することである。金の最終層（不図示）が、層２８４にわたって施されることになるが、これは、結果としての相互接続要素の電気的特性を強化するためである。

【０１１２】最終ステップにおいて、マスキング材料２７２、及び犠牲基板２７４が除去され、結果として、複数の特異な相互接続要素（図12に匹敵）か、又は互いに所定の空間関係を有する複数の相互接続要素（図13に匹敵）のいずれかとなる。

【０１１３】この実施例２７０は、相互接続要素の端部に模様加工の接触先端を製造するための代表的な技法である。この場合、「ニッケルの金上重ね」接触先端の卓越した一例を説明した。しかし、本明細書に記載の技法に従って、他の類似の接触先端が、相互接続要素の端部に製造可能であることも本発明の範囲内である。この実施例２７０の別の特徴は、接触先端が、以前の実施例２５０で意図したような犠牲基板（２５４）の表面内ではなく、犠牲基板（２７４）の頂部全体に構成される点にある。

【０１１４】介在体の概論

上記の技法は、複合相互接続要素を製造するための斬新な技法を一般的に説明するものであり、その物理的特性は、所望の度合いの復元性を呈示するように容易に合わせられる。

【０１１５】一般に、本発明の複合相互接続要素は、介在体として機能する基板に容易に実装（製造）され、介在体は、２つの電子コンポーネントの間に配設され、それらを相互接続し、２つの電子コンポーネントのうちの１つは、介在体の各側に配設される。介在体における輻輳相互接続要素の製造及び使用は、上述の本出願人による米国特許同時係属出願第08/526,426号に詳細に記載されている。

【０１１６】上記の技法は、複合相互接続要素を製造するための斬新な技法を一般的に説明するものであり、その物理的特性は、所望の度合いの復元性を呈示するように容易に合わせられ、また上記の技法は、かかる複合相互接続要素を用いて、介在体を製造する能力を一般的に説明するものである。

【０１１７】一般に、本発明の複合相互接続要素は、相互接続要素の先端が、半導体素子の選択された領域（例えば、接着パッド）と接触すべく配列されるようにして、基板に容易に実装（製造）される。

【０１１８】親事例は、半導体素子にプローブを当てるための各種技法を開示している。

【０１１９】介在体において、本発明の相互接続要素を用いる趣旨は、上記で述べた。一般に、本明細書に用いる「介在体」とは、基板のことであり、その２つの対向した表面上に接触子を有し、２つの電子コンポーネントの間に配設されて、その２つの電子コンポーネントを相互接続する。時折、介在体が、２つの相互接続要素のうちの少なくとも１つの取り外し（例えば、交換、更新その他のために）を可能にすることが望ましい。

【０１２０】介在体実施例＃１

図15は、本発明の相互接続要素を用いた、介在体の１つの実施例３００を示す。一般に、ＰＣＢ型式の基板等の絶縁基板３０２には、複数（図示では多くのうち２つ）の導電性スルーホール（例えば、メッキされたバイア）３０６、３０８その他が設けられ、その各々は、絶縁基板３０２の上部（上側）表面３０２ａ、及び下部（下側）表面３０２ｂにおいて露出した導電部分を有する。

【０１２１】１対の軟質コア３１１及び３１２が、基板３０２の上部表面３０２ａにおいて、スルーホール３０６の露出部分に取り付けられる。１対の軟質コア３１３及び３１４が、基板３０２の下部表面において、スルーホール３０６の露出部分に取り付けられる。同様に、１対の軟質コア３１５及び３１６が、基板３０２の上部表面において、スルーホール３０８の露出部分に取り付けられ、１対の軟質コア３１７及び３１８が、基板３０２の下部表面において、スルーホール３０８の露出部分に取り付けられる。次に、コア３１１－３１８は、硬質材料３０２で保護膜生成されて、相互接続構造３２２及び３２４が、基板３０２の上部表面３０２ａに形成され、また相互接続構造３２６及び３２８が、基板３０２の下部表面３０２ｂに形成される。このようにして、個々のコア３１１－３１８は、スルーホールの対応する露出部分に確実に締結され、相互接続構造３２２は、相互接続構造３２６に電気的に接続され、また、相互接続構造３２４は、相互接続構造３２８に電気的に接続される。ここで理解されたいのは、各相互接続構造（例えば、３２２）を１対の相互接続要素（例えば、３１１、３１２）として設けることにより、外部コンポーネント（不図示）への更に信頼性の良い接続がもたらされる（すなわち、単一の相互接続要素を用いたよりも）、ということである。

【０１２２】図示のように、相互接続要素３１１、３１２、３１５、及び３１６の上部グループは全て、同じ形状で形成され、また相互接続要素の下部グループも全て同じ形状を有する。理解されたいのは、相互接続要素の下部グループには、相互接続要素の上部グループとは異なる形状を設けることができ、それにより、基板の下部表面から延伸する相互接続構造とは異なる機械的特性を有する、絶縁基板の上部表面から延伸する相互接続構造を作り出す機会が与えられる、ということである。

【０１２３】介在体実施例＃２

図16は、本発明の相互接続要素を用いた、介在体の他の実施例３３０を示す。この実施例の場合、複数（図示では多くのうち１つ）の相互接続要素３３２が、犠牲基板（不図示）上に所望のパターン（例えば、アレイ）で製造される。支持基板３３４には、同様に複数の穴３３６が、対応するパターンで設けられる。支持基板３３４は、相互接続要素３３２が、穴３３６を介して延伸するように、相互接続要素３３２にわたって配置される。相互接続要素は、穴３３６を充填する適切な材料３３８（エラストマー等）によって、支持基板内で緩く保持されて、支持基板の上部及び下部表面の両方から延伸する。次に、犠牲基板は除去される。明らかではあるが、支持基板３３４（２６６に匹敵）は、この介在体アセンブリを製造する工程において、犠牲基板（２５４）に実装される複数の相互接続要素（２６４に匹敵）上に単純に「落とす」ことができる。

【０１２４】介在体実施例＃３

図17は、本発明の相互接続要素を用いた、介在体の他の実施例３６０を示す。この実施例３６０は、以前に説明した実施例３３０と類似であるが、相互接続構造３６２（３３２に匹敵）が、支持基板３６４（３３４に匹敵）の穴３６６（３３６に匹敵）内で、支持基板のスルーホール３６６上のメッキ部３６８に、相互接続構造３６２の中間部を半田付けすることにより支持される点を除く。やはり、支持基板３６４（２６６に匹敵）は、この介在体アセンブリを製造する工程において、犠牲基板（２５４）に実装される複数の相互接続要素（２６４に匹敵）上に単純に「落とす」ことができる。

【０１２５】図16及び17は、単一の相互接続要素（３３２、３６２）を用いて、２つの電子コンポーネントの対

応する端子の単一の接続をもたらすことができる、という事実の例示である。ここで、図16及び17に示すような、本発明の相互接続要素の代わりに、任意の導電要素を用いることもできる、ということを理解され、また、それは本発明の範囲内である。

【０１２６】理解されたいのは、図15、16、及び17の介在体実施例において、電子コンポーネント（不図示）は、介在体が、その端子（不図示）間で電気的接続をなすために、介在体（３００、３３０、３６０）の両側に配設される、ということである。

【０１２７】シートからの相互接続要素の形成

上記の説明は主に、軟質ワイヤコアと硬質保護膜が代表例である、成形及び保護膜生成されたワイヤコアから、複合相互接続要素を形成する方法に概ね的を絞った。本発明は又、金属シート、好適には軟質金属シートであり、成形され、好適には硬質材料で保護膜生成される平坦な伸長要素（タブ）を形成するためにパターン化される（型打ち、又はエッチング等により）金属シートから形成される、相互接続要素の形成法にも適用可能である。この内容は、上述の米国特許出願第08/526,246号に詳述されている。

【０１２８】間隔変換器

直ぐ上で説明した図15－17は、本発明に応用できる（適切）である、介在体、及びそれらを製作するための技法を記載している。主に、本発明の複合相互接続要素を説明したが、明確に理解されたいのは、リン青銅及びベリリウム銅から本質的に弾性をもって製作されるモノリシック材料から製作されたばね構造を含めて、任意の復元性のある相互接続要素（スプリング）が使用可能である、ということである。

【０１２９】「間隔変換」（時折、「ピッチ拡張」と呼ばれる）は、本発明に適用可能な重要な概念である。簡単に言えば、復元性のある接触構造の先端が、それらの基底部への接続よりも、互いに近接して間隔を開けられる（比較的微細なピッチ）ことが重要である。上記で説明した図８に示すように、これは、個々のバネ要素（２５１－２５６）を成型及び配向して、互いに収束させ、その結果、個々の復元性のある接触構造が、異なる長さを有する傾向をもたせることにより達成できる。一般に、プローブカード・アセンブリに関連して、プローブ要素（復元性のある接触構造）の全てが、互いに同じ長さを有して、必要とされる複数の信号経路において、一定性が保証されることが非常に重要である。

【０１３０】図18は、本発明に従った、間隔変換器４００の代表的設計を示し、所望の間隔変換は、取り付けられる個々の復元性のある接触構造（不図示）の成型ではなく、間隔変換器の基板４０２によって達成される。

【０１３１】間隔変換器基板４０２は、上部（図で見て）表面４０２ａ、及び下部（図で見て）表面４０２ｂを有し、絶縁材料（例えば、セラミック）と導電材料の交互層を有する多層構成要素として、好適に形成される。この例の場合、１つの配線層が、２つ（多数のうち）の導電トレース４０４ａ及び４０４ｂを含むように図示されている。

【０１３２】複数（図示では多くのうち２つ）の端子４０６ａ及び４０６ｂが、比較的微細なピッチで（互いに比較的近接して）間隔変換器基板４０２の上部表面４０２ａに配設される。複数（図示では多くのうち２つ）の端子４０８ａ及び４０８ｂが、比較的粗いピッチで（端子４０６ａ及び４０６ｂに対して、更に互いから離れて）間隔変換器基板４０２の下部表面４０２ｂに配設される。例えば、下部端子４０８ａ及び４０８ｂは、５０－１００ミルのピッチ（印刷回路基板の制約に匹敵）で配設し、上部端子４０６ａ及び４０６ｂは、５－１０ミルのピッチ（半導体ダイの接着パッドの中心間間隔に匹敵）で配設することができ、結果として１０：１ピッチ変換となる。上部端子４０６ａ及び４０６ｂは、それぞれ、導電トレース４０４ａ及び４０４ｂに端子を接続する、それぞれ、関連した導体４１０ａ／４１２ａ及び４１０ｂ／４１２ｂによって、それぞれ、対応する下部端子４０８ａ及び４０８ｂに接続される。これは全て、多層ランド・グリッド・アレイ（ＬＧＡ）支持基板、その他に関連して、一般的に周知である。

【０１３３】プローブカード・アセンブリ

図19は、プローブカード・アセンブリ５００の１つの実施例を示し、これは、その主要機能構成要素として、プローブカード５０２と、介在体５０４と、間隔変換器５０６とを含み、半導体ウェーハ５０８に対して一時的な相互接続をなすのに適している。この分解組立の断面図において、例示の明瞭化のために、幾つかの構成要素の幾つかの要素を誇張して示している。しかし、各種の構成要素の垂直方向（図示のように）の位置合わせは、図面の点線で適切に示されている。留意されたいのは、相互接続要素（５１４、５１６、５２４、これらは以下で更に詳細に説明する）が部分的ではなく完全に示されている点である。

【０１３４】プローブカード５０２は、一般に、慣用的な回路基板であり、その上部（図で見て）表面に配設された複数（図示では多くのうち２つ）の接触領域（端子）５１０を有する。更なる構成要素（不図示）、例えば、能動及び受動電子コンポーネント、コネクタ、その他をプローブカードに実装することもできる。回路基板上の端子５１０は、通常、１００ミルのピッチ（ピッチは上記で規定される）で配列される。プローブカード５０２は、適切に丸みを帯び、１２インチ程度の直径を有する。

【０１３５】介在体５０４には、基板５１２（基板３０２に匹敵）が含まれる。上記のようにして、複数（図示では多くのうち２つ）の復元性のある相互接続要素５１４が、基板５１２の下部（図で見て）表面に実装され

（それらの近位端により）て、そこから下方（図で見て）に延伸し、また対応する複数（図示では多くのうち２つ）の復元性のある相互接続要素５１６が、基板５１２の上部（図で見て）表面に実装され（それらの近位端により）て、そこから上方（図で見て）に延伸する。上述のスプリング形状のいずれもが、好適には本発明の複合相互接続要素である、復元性のある相互接続要素５１４及び５１６に適している。一般的な提案として、相互接続要素５１４及び５１６のうち、下側複数５１４及び上側複数５１６の両方の先端（遠位端）は、プローブカード５０２の端子５１０のピッチに一致するピッチであり、例えば１００ミルである。

【０１３６】相互接続要素５１４及び５１６は、例示の明瞭化のために、誇張尺度で示されている。典型的には、相互接続要素５１４及び５１６は、介在体基板５１２の対応する下部及び上部表面から、２０－１００ミルの全体長にまで延伸することになる。一般に、相互接続要素の高さは、所望のコンプライアンスの大きさから決まる。

【０１３７】間隔変換器５０６には、適切に回路化された基板５１８（上記の４０２に匹敵）が含まれ、これは例えば、多層セラミック基板であり、その下側（図で見て）表面に配設された複数（図示では多くのうち２つ）の端子（接触領域、パッド）５２０と、その上側（図で見て）表面に配設された複数（図示では多くのうち２つ）の端子（接触領域、パッド）５２２を有する。この例の場合、下側の複数の接触パッド５２０は、相互接続要素５１６の先端のピッチ（例えば、１００ミル）で配設され、上側の複数の接触パッド５２２は、より微細な（近接した）ピッチ（例えば、５０ミル）で配設される。これら復元性のある相互接続要素５１４及び５１６は、好適であるが、必ずしも本発明の複合相互接続要素（上記の２１０に匹敵）である必要はない。

【０１３８】複数（図示では多くのうち２つ）の復元性のある相互接続要素５２４（「プローブ」、「プローブ要素」）が、端子（接触パッド）５２２に直接（すなわち、端子にプローブ要素を接続するワイヤ等の追加の材料からなる仲介物なく、又は端子にプローブ要素をろう接、半田付けすることなく）実装されて（それらの近位端により）、間隔変換器基板５１８の上部（図で見て）表面から上方（図で見て）に延伸する。図示のように、これら復元性のある相互接続要素５２４は、それらの先端（遠位端）が、それらの近位端よりも更に微細なピッチ（例えば、１０ミル）で間隔を開けられ、それにより、間隔変換器５０６のピッチ低減が増強されるように、適切に配列される。これら復元性のある接触構造（相互接続要素）５２４は、好適であるが、必ずしも本発明の複合相互接続要素（上記の２１０に匹敵）である必要はない。

【０１３９】プローブ要素（５２４）が、犠牲基板上に製造され（図９－11に匹敵）、続いて間隔変換器構成要素（５０６）の端子（５２２）に個々に実装される（図12に匹敵）か、又はそれら端子に一括移転される（図13に匹敵）ことが可能であることも、本発明の範囲内である。

【０１４０】周知のように、半導体ウェーハ５０８には、その前部（図で見て下側）表面に、ホトリソグラフィ、堆積、拡散、その他により形成される、複数のダイ・サイトが含まれる。典型的には、これらのダイ・サイトは、互いに同じに製造される。しかし、周知のように、ウェーハ自体の欠陥、又はウェーハが、ダイ・サイトの形成に被る工程のいずれかにおける欠陥のどちらかによって、結果として、幾つかのダイ・サイトが、十分に確立した試験基準に従って、機能不全となる可能性がある。しばしば、半導体ウェーハから半導体ダイを単一化する前に、ダイ・サイトにプローブを当てることに付随の困難性に起因して、試験工程は、半導体ダイを単一化、及び実装した後に実施される。欠陥が、半導体ダイの実装後に発見された場合、正味の損失は、半導体ダイの実装に付随する費用により悪化する。半導体ウェーハは通常、少なくとも６インチの直径を有するが、少なくとも８インチも含む。

【０１４１】各ダイ・サイトは通常、多数の接触領域（例えば、接着パッド）を有し、これらは、ダイ・サイトの表面上の任意の場所に、及び任意のパターンで配設できる。ダイ・サイトのうちの１つの２つ（多くのうち）の接着パッド５２６が図面に示されている。

【０１４２】ダイ・サイトを個々の半導体ダイへと単一化する前に、ダイ・サイトを試験するために、限定数の技法が知られている。代表的な従来技術の技法には、セラミック基板に埋め込まれて、そこから延伸する複数のタングステン「針」を有する、プローブカード挿入の製造が伴い、各針は、接着パッドのうちの所与のパッドに対して、一時的な接続をなす。かかるプローブカード挿入は、高価で、製造するのに幾分複雑であり、その結果として、それらの費用が比較的高くなり、それらを得るのに相当なリードタイムがかかることになる。半導体ダイにおいて可能性のある、各種各様の接着パッドが与えられると、各独特の配列には、特異なプローブカード挿入が必要となる。

【０１４３】独特の半導体ダイを製造する速さは、短い所要時間で、製造するのに単純且つ安価であるプローブカードに対する緊急の要求を際立たせる。プローブカード挿入として、間隔変換器（５０６）及び介在体（５０４）を用いることが、この抑止できない要求に真っ向から対処する。使用時に、介在体５０４は、プローブカード５０２の上部（図で見て）表面に配設され、間隔変換器５０６は、相互接続要素５１４が、プローブカード５０２の接触端子５１０と信頼性の良い圧力接触をなして、相互接続要素５１６が、間隔変換器５０６の接触パ

ッド５２０と信頼性の良い圧力接触をなすように、介在他５０４の頂部（図で見て）に積み重ねられる。これらの構成要素を積み重ねて、かかる信頼性の良い圧力接触を保証するのに、適切な任意の機構を使用することができ、その適切な機構を以下で説明する。

【０１４４】プローブカード・アセンブリ５００は、介在体５０４と間隔変換器５０６をプローブカード５０２上に積み重ねるために、以下の主要な構成要素を含む。すなわち、ステンレス鋼等の堅固な材料製の背部実装プレート５３０と、ステンレス鋼等の堅固な材料製のアクチュエータ実装プレート５３２と、ステンレス鋼等の堅固な材料製の前部実装プレート５３４と、外部の差動ネジ要素５３６、及び内部の差動ネジ要素５３８を含む、複数（図示では多くのうち２つであるが、３つが好適である）の差動ネジと、リン青銅等の弾力のある材料から好適に製作されて、そこから延伸する弾力のあるタブ（不図示）の１つのパターンを有する、実装リング５４０と、実装リング５４０を前部実装プレート５３４に、それらの間に捕捉された間隔変換器５０６と共に保持するための複数（図示では多くのうち２つ）のネジ５４２と、任意として、製造公差を吸収するために、実装リング５４０と間隔変換器５０６の間に配設されるスペーサリング５４４と、差動ネジ（例えば、内部の差動ネジ要素５３８の頂部）の頂部（図で見て）に配設される、複数（図示では多くのうち２つ）の枢軸球５４６である。

【０１４５】背部実装プレート５３０は、プローブカード５０２の下部（図示のように）表面に配設された、金属プレート又はリング（リングとして図示）である。複数（図示では多くのうち１つ）の穴５４８が、背部実装プレートを介して延伸する。

【０１４６】アクチュエータ実装プレート５３２は、背部実装プレート５３０の下部（図示のように）表面に配設された、金属プレート又はリング（リングとして図示）である。複数（図示では多くのうち１つ）の穴５５０が、アクチュエータ実装プレートを介して延伸する。使用時に、アクチュエータ実装プレート５３２は、ネジ（例示の明瞭化のために図面からは省略されている）等による任意の適切な仕方で、背部実装プレート５３０に固定される。

【０１４７】前部実装プレート５３４は、堅固な、好適には金属のリングである。使用時に、前部実装プレート５３４は、プローブカード５０２を介した対応する穴（例示の明瞭化のために図面からは省略されている）を貫通するネジ（例示の明瞭化のために図面からは省略されている）等による任意の適切な仕方で、背部実装プレート５３０に固定され、それによって、プローブカード５０２は、前部実装プレート５３４と背部実装プレート５３０の間で確実に捕捉される。

【０１４８】前部実装プレート５３４は、プローブカード５０２の上部（図で見て）表面に対して配設される、平坦な下部（図で見て）表面を有する。前部実装プレート５３４は、図示のように、それを介する大きな中央開口を有し、これは、プローブカード５０２の複数の接触端子５１０が、前部実装プレート５３４の中央開口内にあるのを可能にすべく寸法決められる、内部エッジ５５２によって規定される。

【０１４９】上述のように、前部実装プレート５３４は、平坦な下部（図で見て）表面を有するリング状構造である。前部実装プレート５３４の上部（図で見て）表面には、段差が付けられ、前部実装プレートは、その内部領域よりも、その外部領域において厚く（図で見て、垂直方向の大きさ）なっている。段差、又は肩部は、点線（５５４で表記）の位置に配置されて、間隔変換器５０６が、前部実装プレートの外部領域を外して、前部実装プレート５３４の内部領域上に載ることを可能にすべく寸法決められる（しかし、お分かりと思うが、間隔変換器は、実際には枢軸球５４６上に載る）。

【０１５０】複数（図示では多くのうち１つ）の穴５５４が、前部実装プレート５３４を少なくとも部分的に介して、その上部（図で見て）表面から、前部実装プレート５３４の外部領域へと延伸し（これらの穴は、図面では、前部実装プレート５３４を部分的にしか介さずに延伸するよう示されている）、これらはお分かりのように、対応する複数のネジ５４２の端部を受ける。この目的のために、穴５５４はねじ切り穴である。これによって、間隔変換器５０６を、実装リング５４０で前部実装プレートに固定し、ゆえにプローブカード５０２に対して押圧することが可能になる。

【０１５１】複数（図示では多くのうち１つ）の穴５５８が、前部実装プレート５３４の厚い内部領域を完全に介して延伸し、プローブカード５０２を介して延伸する対応した複数（図示では多くのうち１つ）の穴５６０と位置合わせされ、順に、背部実装プレート内の穴５４８、及びアクチュエータ実装プレート５３８内の穴５５０と位置合わせされる。

【０１５２】枢軸球５４６は、内部の差動ネジ要素５３８の上（図で見て）端において、整合した穴５５８及び５６０内で緩く配設される。外部の差動ネジ要素５３６は、アクチュエータ実装プレート５３２の（ねじ切り）穴５５０内へと通され、内部の差動ネジ要素５３８は、外部の差動ネジ要素５３６のねじ切りボア内へと通される。このようにして、非常に微細な調整を、個々の枢軸球５４６の位置においてなすことができる。例えば、外部の差動ネジ要素５３６は、７２ネジ／インチの外部ネジ山を有し、内部の差動ネジ要素５３８は、８０ネジ／インチの外部ネジ山を有する。アクチュエータ実装プレート５３２内へと、１回転、外部の差動ネジ要素５３６を進ませて、対応する内部の差動ネジ要素５３８を静止状態（アクチュエータ実装プレート５３２に相対して）に保つことにより、対応する枢軸球の正味の位置変化

は、「プラス」１／７２（０．０１３９）インチ「マイナス」１／８０（０．０１２５）インチ、すなわち０．００１４インチとなる。これによって、プローブカード５０２に面対向した間隔変換器５０６の平面性の手軽で精密な調整が可能になる。ゆえに、プローブ（相互接続要素）の先端（図で見て、上端）の位置変更が、プローブカード５０２の配向を変えることなく可能となる。この特徴と、プローブの先端の位置合わせを実施するための技法と、間隔変換器の平面性を調整するための代替機構（手段）の重要性を、図25に関連して、以下で更に詳細に説明する。明らかではあるが、介在体５０４は、介在体の２つの表面に配設された復元性のある又は従順な接触構造のおかげで、間隔変換器の調整範囲を通じて、電気的接続が、間隔変換器５０６とプローブカード５０２の間で維持されることを保証する。

【０１５３】プローブカード・アセンブリ５００は、以下のステップによって簡単に組み立てられる。すなわち、相互接続要素５１４の先端が、プローブカード５０２の接触端子５１０と接触するように、前部実装プレート５３４の開口５５２内に介在体５０４を配置するステップと、相互接続要素５１６の先端が、間隔変換器５０６の接触パッド５２０と接触するように、介在体５０４の上部に間隔変換器５０６を配置するステップと、任意ステップであって、間隔変換器５０６の頂部に、スペーサ５４４を配置するステップと、スペーサ５４４にわたって実装リング５４０を配置するステップと、実装リング５４０を介したネジ５４２を、スペーサ５４４を介して、前部実装プレート５３４の穴５５４内に挿入するステップを含む任意ステップと、背部実装プレート５３０及びプローブカード５０２を介して、前部実装プレート５３４の下部（図で見て）表面内のねじ切り穴（不図示）内に、ネジ（１つは符号５５５として部分的に図示される）を挿入することにより、「サブアセンブリ」をプローブカード５０２に実装するステップである。

【０１５４】アクチュエータ実装プレート５３８が、次いで、背部実装プレート５３０に組み付けられ（例えば、そのうちの１つが、５５６として部分的に図示されるネジで）、枢軸球５６０が、アクチュエータ実装プレート５３２の穴５５０内に落とされて、差動ネジ要素５３６及び５３８が、アクチュエータ実装プレート５３２の穴５５０内に挿入できる。

【０１５５】このようにして、プローブカード・アセンブリがもたらされ、これは、今日の接着パッド間隔に見合っている微細ピッチで、半導体ウェーハからのダイの単一化に先行して、半導体ダイ上の複数の接着パッド（接触領域）と接触させるために、アセンブリから延伸する複数の復元性のある接触構造（５２４）を有する。一般に、使用時には、アセンブリ５００は、図示のところから上側を下にして使用されることになり、半導体ウェーハは、復元性のある接触構造（５２４）の先端へと押し上げられる（図示しない外部機構により）。

【０１５６】図面から明らかなように、前部実装プレート（ベースプレート）５３４は、プローブカード５０２と面対向の介在体５０４の位置を決定する。プローブカード５０２と面対向した前部実装プレート５３４の正確な位置決めを保証するために、複数の位置合わせ特徴（図示の明瞭化のために図面から省略されている）、例えば、前部実装プレートから延伸するピン、及びプローブカード５０２内へと延伸する穴を設けることができる。

【０１５７】任意の適切な復元性のある接触構造（５１４、５１６、５２４）が、それぞれ介在体、又は間隔変換器上の接触領域にろう接、又は半田付けされる、リン青銅材料その他のタブ（リボン）を含む、介在体（５０４）及び／又は間隔変換器（５０６）上に用いることも、本発明の範囲内である。

【０１５８】介在体（５０４）及び間隔変換器（５０６）が、上述した本出願人による同時係属のPCT/US94/13373の図２９の要素４８６として記載され、介在体基板から延伸する、ばねクリップ等によって、互いに予備組み付け可能であることも、本発明の範囲内である。

【０１５９】介在体（５０４）を省いて、その代わりに、５１４に匹敵する複数の復元性のある接触構造を、間隔変換器の下側表面の接触パッド（５２０）に直接実装することも、本発明の範囲内である。しかし、プローブカードと間隔変換器の間で共平面性を達成することは困難であろう。介在体の主な機能は、かかる共平面性を保証するコンプライアンスをもたらすことである。

【０１６０】図20は、図19のプローブカード・アセンブリ５００に適した間隔変換器基板５１８の斜視図である。そこに示されるように、間隔変換器基板５１８は、長さ「Ｌ」、幅「Ｗ」、及び厚さ「Ｔ」を有する矩形の立体が適している。この図で、間隔変換器基板５１８の上部表面５１８ａは見えており、そこに、プローブ検査の相互接続要素（５２４に匹敵）が実装される。図示のように、複数（数百等）の接触パッド５２２が、その所定領域において、間隔変換器基板５１８の上部表面５１８ａに配設される。この所定領域は、５７０で表記される点線で示され、明らかなように、接触パッド５２２は、その所定領域５７０内において、任意の適切なパターンで配列することができる。

【０１６１】上述したように、間隔変換器基板５１８は、多層セラミック基板として適切に形成され、セラミック材料とパターン化された導電材料の交互層を有する。

【０１６２】かかる多層セラミック基板の製造は、周知のところであり、例えばランド・グリッド・アレイ（ＬＧＡ）半導体パッケージの製造の際に用いられる。かかる多層基板内でパターン化された導電材料を適切に経路指定することにより、基板５１８の上部表面５１８ａの

接触パッド５２２のピッチとは異なる（例えば、より大きい）ピッチで、基板５１８の下部表面（この図では見えない）に接触パッド（この図では見えないが、５２０に匹敵）を配設すること、及び基板５１８内部で互いに、接触パッド５２０を接触パッド５２２と接続することが簡単明瞭である。かかる基板上で、接触パッド５２０と接触パッド５２２の間の約１０ミルのピッチを達成することは、大いに実現可能である。

【０１６３】図20は、間隔変換器基板５１８の好適な特徴を示す。上述したように、基板５１８は、上部表面５１８ａ、下部表面（この図では視界から隠れている）、及び４つの側部エッジ５１８ｂ、５１８ｃ、５１８ｄ、５１８ｅを有する矩形立体である。図示のように、ノッチ５７２ｂ、５７２ｃ、５７２ｄ及び５７２ｅが、対応する側部エッジ５１８ｂ、５１８ｃ、５１８ｄ及び５１８ｅと、基板５１８の上部表面５１８ａとの交差部に沿って、また対応する側部エッジ５１８ａ－５１８ｅのほぼ全体長（角部を除いた）に沿って設けられる。これらのノッチ５７２ｂ－５７２ｅは、多層セラミック構造としての間隔変換器の製造を概ね容易にし、図19の例示にも見えている。ここで理解されたいのは、ノッチは必ずしも必要ではないということである。明らかではあるが、基板５１８の４つの角部にはノッチがない（これは、セラミックの多層基板を製作する工程により基本的に示される）ので、実装プレート（図19の５４０）は、これらの角部の「特徴」に明確に適応する必要がある。

【０１６４】図21は、以前に説明した間隔変換器５１８に匹敵し、図19のプローブカード・アセンブリ５００に同様に使用可能である、間隔変換器５７４の１つの実施例を示す。この場合、複数（図示では多くのうち４つ）の領域５７０ａ、５７０ｂ、５７０ｃ及び５７０ｄが規定され、その各々内に、複数の接触パッド５２２ａ、５２２ｂ、５２２ｃを、任意の所望パターンで容易に配設することができる。概ね意図するところは、領域５７０ａ－５７０ｄの間隔が、半導体ウェーハ上のダイ・サイトの間隔に対応するので、複数のダイ・サイトを、プローブカードの単一「パス」で同時にプローブ検査可能である点である。（これは、１つの半導体ウェーハ上にある多数のメモリチップにプローブを当てるのに特に有用である。）典型的には、基板５７４の領域５７０ａ－５７０ｄ内の対応する接触パッド５２２ａ－５２２ｄのパターンは、互いに同一とはならないが、これは、絶対的に必要というわけではない。

【０１６５】図21の例示は、単一の間隔変換器に、半導体ウェーハ上の複数（例えば、図示では４つ）の隣接したダイ・サイトにプローブを当てる（圧力接触をなす）ために、プローブ要素を設けることが可能であることを明らかに実証している。これは、ウェーハ上のダイ・サイトの全てにプローブを当てるのに必要なセットダウン（ステップ）数の低減に有利である。例えば、１つのウェーハ上に１００個のダイ・サイトと、間隔変換器上に４組のプローブ要素が存在すると、ウェーハに必要なのは、間隔変換器に対して２５回の位置決めだけである（この例の目的のために、ウェーハのエッジ（周辺）での効率が、幾分減衰されることを無視したとして）。プローブ・サイト（例えば、５７０ａ－５７０ｄ）の配列だけでなく、個々のプローブ要素（例えば、千鳥状の）の配向も、ウェーハ全体にプローブを当てるのに必要なタッチダウン数を最小化すべく最適化できることは、本発明の範囲内である。交互のプローブ要素が、ウェーハ上の２つ隣のダイ・サイトの異なるダイ・サイトと接触するようにして、プローブ要素が、間隔変換器の表面に配列可能であることも、本発明の範囲内である。プローブ要素が全て、同じ全体長を有することが一般に望ましいという前提の場合、明らかではあるが、プローブ要素が、間隔変換器の２次元表面上のいかなる点にも直接取り付け（実装）可能であるという、制約を受けない仕方は、プローブ要素のプローブカードへの取付け場所に制約を与えるいずれの技法よりも優れている（例えば、上記のようなリング配列）。このようにして、１つのウェーハ上の複数の隣接しないダイ・サイトにプローブを当てられることも、本発明の範囲内である。本発明は、１つのウェーハ上の単一化されていないメモリ素子にプローブを当てることに特に有利であり、また、任意のアスペクト比を有するダイ・サイトにプローブを当てるのに有用である。

【０１６６】図22は、間隔変換器基板５１８の下部表面における接触パッド５２０の例示的なレイアウトを示し、パッド５２０は、１００ミルのピッチを有するパターンで配列され、パッドの各列は、パッドの隣接列から千鳥状にされ、また各パッドは、約５５ミルの直径を有する。

【０１６７】図23は、例示的な介在体基板５８０（５１２に匹敵）の上部表面、又は下部表面のいずれかの平面図であり、相互接続要素（５１４、５１６）が実装される導電領域（図19には不図示、図15に匹敵）の例示的なレイアウトを示す。図24は、同一の介在体基板５８０の一部の断面図である。図24に示すように、複数のメッキされたスルーホール５８２が、基板５８０を介して、その一方の表面５８０ａから対向する表面５８０ｂに延伸する。基板（板）自体は、メッキされたスルーホールを製造するための慣用的な技法を用いて、慣用的な回路基板材料から形成される。この例の場合、「ベース」基板５８４は、銅の層である、極めて薄い（例えば、１００マイクロインチ）「ブランケット」層５８６で初期に被覆される。ホトレジスト層５８８が、基板の両面に施されて、スルーホール５８２のメッキ上がりを可能にする開口を有するようにパターン化される。スルーホール５８２は、約１ミルの厚い銅層でメッキされ、この層にわたって、ニッケルの層である、薄い（例えば、少なくと

も１００マイクロインチ）障壁層５９２が堆積され、この層にわたって、軟質（純）金の薄い（例えば、少なくとも５０マイクロインチ）層５９４が堆積される。次に、ホトレジスト層５８８が除去されて、初期の極めて薄い銅層５８６の痕跡が、メッキされたスルーホール５８２の外側領域から除去される。図23に示すように、メッキされたスルーホール５８２により形成される各接触領域の平面図は、円形リングの平面図であり、そこから延伸する１つのタブを備える。このタブは、基板５８０の表面において露出した（相互接続要素の実装のために）スルーホールの導電領域（パッド）の配向を規定する。パッドは、１００ミルのピッチの千鳥列で配列され、それらの配向（それらのタブにより決定される）は、基板表面の中央線において反転する。

【０１６８】上記の例示的なプローブカード・アセンブリ５００に関して、以下の寸法、及び材料が、所定用途に対して代表的である。

【０１６９】ａ．間隔変換器基板５１８は、２．５インチの長さ（Ｌ）、２．５インチの幅（Ｗ）、０．２５インチの厚さ（Ｔ）、及びセラミックとパターン化された導体からなる少なくとも３つの交互層を有する。

【０１７０】ｂ．赫々変換器基板５１８から延伸する相互接続要素５２４は、本発明の複合相互接続要素であり、１．０ミルの直径の金ワイヤコアを有し、これは、１．５ミルのニッケルで保護膜生成され、４．０ミルの全体径となる。相互接続要素５２４の全長は４０ミルである。

【０１７１】ｃ．介在体基板５１２は、慣用的な回路基板材料から形成され、１．８５０インチの側寸法、及び１６ミルの厚さを有する。

【０１７２】ｄ．介在体基板５１２から延伸する相互接続要素５１４及び５１６は、本発明の複合相互接続要素であり、１．０ミルの直径の金ワイヤコアを有し、これは、１．５ミルのニッケルで保護膜生成され、４．０ミルの全体径となる。相互接続要素５１４及び５１６の全長は６０ミルである。

【０１７３】相互接続要素５１４及び５１６が、単一の相互接続要素として図19に示されるが、図示の各々の要素は、図15に関連して上記で説明したようにして、２つ以上の相互接続要素を有する１つの相互接続構造として容易に実施されて、信頼性の良い圧力接触を、プローブカード５０２の対応する接触端子５１０、及び間隔変換器５０６の接触パッド５２０に対してなすのが保証されることは、本発明の範囲内であり、また、一般に好適である。

【０１７４】明確に理解されたいのは、間隔変換器（５０６、５１８、５７４）、及び介在体（５０４、５８０）が、末端ユーザに「キット」（又は「サブアセンブリ」）として供給可能であり、その場合に、末端ユーザは、プローブカード及び関連実装ハードウェア（例えば、５３０、５３２、５３４、５３６、５３８、５４０、５４４）を供給することになるということである。

【０１７５】図面及び以上の説明において、本発明を詳細に例示及び説明してきたが、本発明は、文言における限定としてではなく、例示として見なされるべきである。すなわち、ここで理解されたいのは、好適な実施例のみを図示及び説明したということ、及び本発明の趣旨内に入る全ての変形及び修正も、望ましく保護されるということである。疑うべくもなく、上記の「主題」に関する多数の他の「変形例」も、本発明の最も近くに属する、当該技術で通常の知識を有する者が想到するであろうし、また本明細書に開示されるような変形例は、本発明の範囲内にあることを意図するものである。これら変形例の幾つかは、親事例に記載されている。

【０１７６】プローブカード・アセンブリの位置合わせ

図25は、図19のプローブカード・アセンブリ５００等のプローブカード・アセンブリを位置合わせする技法７００を示す。この目的のために、この図において、図19のプローブカード・アセンブリ５００の要素の幾つかが同じ符号（５ｘｘ）を持つ。図25は、主要構成要素が互いに接触した、部分的組立図である。

【０１７７】本発明が真っ向から対処する問題は、試験しようとする半導体ウェーハに対して、プローブカード（又は、プローブカード挿入）の接触先端を位置合わせするのが困難であることが多い、という点である。プローブの先端とウェーハの表面との共平面性に関する公差を最小限に保って、各プローブ（すなわち、復元性のある接触構造５２４）の各先端５２４ａ（図で見て、上端）において、均一で信頼性の良い圧力接触を保証することが本質的である。上記で説明したように、プローブカード・アセンブリには、間隔変換器５０６に基づいて動作させることにより、プローブの先端５２４ａの平面性を調整するための機構（例えば、差動ネジ５３６及び５３８）が設けられる。この図において、間隔変換器基板５０６は、上記の図18に示すようにして、その上部端子と下部端子の間で内部接続がなされて示されている。

【０１７８】プローブカード・アセンブリを使用して、半導体ウェーハに関する試験を実施する前に、プローブ先端の整合性が測定され、必要であれば、プローブ先端５２４ａが、プローブカード・アセンブリに続いて提供される（すなわち、プローブ先端に対して押圧される）半導体ウェーハと共平面となることを保証するように調整される。

【０１７９】一般に、プローブカード・アセンブリが実装されるウェーハ試験装置は、半導体ウェーハをプローブカード・アセンブリへと搬送して、プローブ先端５２４ａに対して半導体ウェーハを押圧するための機構（不図示）を有する。この目的のために、半導体ウェーハは、チャック機構（不図示）により保持される。この説明の目的のために、仮定として、試験装置及びチャック

機構が、精密で反復可能な場所及び配向へと、ウェーハを次々に移動させることが可能であるとする。ここで、ウェーハの精密な場所は、「基準面」として機能する。

【０１８０】本発明によれば、半導体ウェーハの期待される配向と面対向して、換言すれば、基準面と面対向して先端５２４ａを位置合わせするために、平坦な導電金属プレート７０２が、半導体ウェーハの代わりに試験装置内に実装される。平坦な金属プレート７０２は、プローブの先端５２４ａを位置合わせするという目的のために、「代用」ウェーハ、又は「仮想」ウェーハとして機能する。

【０１８１】各プローブ５２４は、プローブカード５０２上の複数の端子（不図示）のうちの１つの端子と関連付けられ、それらの間の導電経路は、プローブ５２４のうちの選択された１つ、復元性のある接触構造５１６のうちの関連する選択された１つ、復元性のある接触構造５１４のうちの関連する選択された１つ、及びプローブカード５０２内の配線層（不図示）によって構成される。プローブカード端子は、表面端子、ソケットの端子、その他の形式とすることができる。ケーブル７０４が、プローブカード５０２と、表示モニタ７０８を有するコンピュータ（試験装置）との間を接続する。本発明は、コンピュータ装置の使用にも、表示モニタの使用にも限定されない。

【０１８２】この例において、仮定として、１００個の圧力接触を、１０×１０の矩形アレイに配列される１００個のプローブ先端５２４ａと、１つのウェーハの１００個の端子（例えば、接着パッド）との間にもたらすことが求められるとする。しかし、本発明は、プローブ先端の特定数、及び接着パッドの特定レイアウトには限定されない。

【０１８３】平坦な金属プレート７０２は、チャック（不図示）により担持されて、プローブ先端５２４ａに対して押圧される（表記「Ａ」の矢印で示すように進められる）。これは比較的徐々に行われ、その結果、プローブ先端５２４ａが全て、平坦な金属プレートに一斉に（見込みはないが）接触するかどうか、又はプローブ先端５２４ａの幾つかが、プローブ先端５２４ａの残りに先行して、平坦な金属プレート７０２により接触されるかどうかが確認できる。図示において、モニタ７０８上の領域７１０内の７１個の塗りつぶし円（ドット）は、プローブ先端５２４ａのうちの７１個が、プローブ先端５２４ａの残りの２９個（空白の円として図示）が平坦な金属プレート７０２に接触する前に、平坦な金属プレート７０２に既に接触していることを示す。この視覚的表現に基づいて、明らかであるが、間隔変換器５０６（又は、恐らく、金属プレート７０２）は、左（図で見て）下方へと（図で見て、頁から外に）偏って（傾いて）おり、間隔変換器５０６の配向は、差動ネジ５３６及び５３８の適切な調整によって、容易に調整可能である。

【０１８４】プローブカード５０２の配向を変更することなく、プローブ先端５２４ａの全てが、平坦な金属プレート７０２と実質的に同時に接触するような、平坦な金属プレート７０２との先端５２４ａの全ての平面同時接触の所望目標を達成するのに必要な調整は、オンライン、又はオフラインのどちらかで容易に計算される。計算された調整をなすことにより、プローブ５２４の先端５２４ａは、続いて、試験しようとする半導体ウェーハ上の接着パッドと、実質的に同時に接触することになる。

【０１８５】以前の段落で説明した試験の「可／否」（接触／非接触）型式は、本発明のプローブカード・アセンブリにより容易となる、第１「番目」の位置合わせを示す。第２「番目」の位置合わせは、プローブ要素先端が金属プレートに接触するシーケンス（順番）を記録する（例えば、コンピュータ・メモリに）ことにより、容易に実施される。金属プレートに接触する最初の先端は、一般に、あまりにも「高い」、間隔変換器の角部を表し、下げる必要がある（例えば、差動ネジを調整することにより）。同様に、金属プレートに接触する最後の先端は、あまりにも「低い」、間隔変換器の角部を表し、上げる必要がある（例えば、差動ネジを調整することにより）。金属プレートに接触する先端のシーケンスに基づいて、なすべき必要のある調整を決定するために、任意の適切なアルゴリズムを使用可能なことは、本発明の範囲内である。各プローブ先端５２４ａと平坦な金属プレート７０２の間の抵抗（例えば、接地に対する）を測定して、単に、表示モニタ上の塗りつぶされていない円に対する塗りつぶされた円としてではなく、測定された抵抗を表す、数値、記号、ドット色又はその他として表示可能であるが、かかることは一般に好適ではない。

【０１８６】間隔変換器５０６の配向を調整する、換言すれば、プローブ５２４の先端５２４ａを平坦化するために、任意の適切な機構を使用可能なことは、本発明の範囲内である。上記で説明した差動ネジ（５３６、５３８）の利用の代替例は、サーボ機構、圧電駆動装置又はアクチュエータ、磁気歪み装置、それらの組合せ（例えば、粗調及び微調のために）、又はかかる平坦化を達成するその他を利用することであろう。

【０１８７】図26は、間隔変換器（ここには不図示）の空間配向を調整するための自動化技法７５０を示す。この例において、アクチュエータ機構５５２（「ＡＣＴ」で表記）が、差動ネジ（５３６、５３８）に対して置き換えられて、コンピュータ７０６からの信号に応答して作動する。３つのかかる機構５５２で、単純明瞭に、３対の差動ネジ要素を置き換えることができる。図26の類似の要素には、図25に見られる同一の符号が付され、図25に見られる幾つかの要素は、図示の明瞭化のために、

図26の視界から省かれている。

【０１８８】間隔変換器（５０６）を平坦化するための機構（特に、図26に示す自動化機構）が、本明細書に記載の代表的な実施例に示す以外に配設可能なことも、本発明の範囲内である。例えば、適切な機構が、プローブカード（５０２）の上部（図で見て）表面と前部実装プレート（５３４）との間に配置可能であり、又は前部実装プレート（５３４）内に組み込むことも可能である。これらの機構のいずれかを用いることの重要な特徴は、プローブカード（５０２）の配向を変更する必要なく、間隔変換器（５０６）の角度（配向）を変更できる能力にある。

【０１８９】プローブ要素用先端構造の予備製造、プローブ要素の処理、及びプローブ要素への先端構造の連結

上記で説明した図９－11は、犠牲基板（２５４）上に先端構造（２５８）を製造して、続く、電子コンポーネントの端子への実装のために、先端構造（２５８）上に複合相互接続要素２６４を製造するための技法を開示している。かかる技法は、間隔変換器（５１８）の上部表面に、製造済みの先端構造を有する複合相互接続要素を実装することに関連して、確かに使用可能である。

【０１９０】図27は、間隔変換器の頂部にある復元性のある接触構造として特に有用な、製造済みの先端構造を有する複合相互接続要素を製造するための代替技法８００を示し、これを次に説明する。この例において、上部（図で見て）表面を有するシリコン基板（ウェーハ）８０２が、犠牲基板として用いられる。チタンの層８０４が、シリコン基板８０２の上部表面に堆積され（例えば、スパッタリングにより）、約２５０Å（１Å＝０．１ｎｍ＝10^{-10} ｍ）の厚さを有する。アルミニウムの層８０６が、チタン層８０４の頂部に堆積され（例えば、スパッタリングにより）、約１０，０００Åの厚さを有する。チタン層８０４は、任意であり、アルミニウム層８０６用の接着層として機能する。銅の層８０８が、アルミニウム層８０６の頂部に堆積され（例えば、スパッタリングにより）、約５，０００Åの厚さを有する。マスキング材料（例えば、ホトレジスト）の層８１０が、銅層８０８の頂部に堆積され、約２ミルの厚さを有する。マスキング層８１０は、任意の適切な仕方で処理されて、ホトレジスト層８１０を介して、下にある銅層８０８へと延伸する複数（図示では多くのうち３つ）の穴８１２を有する。例えば、各穴８１２の直径は、６ミルとすることができ、穴８１２は、１０ミルのピッチ（センター間）で配列できる。犠牲基板８０２は、このようにして、以下のような、穴８１２内に複数の多層接触先端の製造に対して準備されている。

【０１９１】ニッケルの層８１４が、メッキ等により、銅層８０８上に堆積され、約１．０－１．５ミルの厚さを有する。任意として、ロジウムといった貴金属の薄い層（不図示）を、ニッケルの堆積の前に、銅層上に堆積することも可能である。次に、金の層８１６が、メッキ等により、ニッケル８１４上に堆積される。ニッケルとアルミニウム（及び、任意として、ロジウム）の多層構造は、製造済みの先端構造（８２０、図28に示す）として機能することになる。

【０１９２】次に、図28に示すように、ホトレジスト８１０は、剥離除去され（任意の適切な溶剤を用いて）、銅層８０８の頂部に載置する複数の製造済み先端構造が残る。次に、銅層（８０８）は、急速エッチング工程を被り、それによって、アルミニウム層８０６が露出する。明らかなように、アルミニウムは、半田及びろう材料に対して実質的に非湿潤性であるので、後続のステップにおいて役立つ。

【０１９３】ここで言及すべきは、ホトレジストを追加の穴でパターニングし、その穴内で、「代用」先端構造８２２が、先端構造８２０の製造に用いられるのと同じ工程ステップで製造されることが好ましい、ということである。これらの代用先端構造８２２は、周知且つ理解される仕方で上記のメッキステップを均一化するよう機能し、それにより、急勾配（非均一性）が、メッキしようとする表面を横切って現れるのが低減される。かかる構造（８２２）は、メッキの分野で「ラバー(robbers)」として知られている。

【０１９４】次に、半田付け又はろう接ペースト（「連結材料」）８２４が、先端構造８２０の上部（図で見て）表面上に堆積される。（代用先端構造８２２の上部にペーストを堆積する必要はない。）これは、ステンレス鋼スクリーン、又はステンシル等により、任意の適切な仕方で実施される。典型的なペースト（連結材料）８２４は、例えば、１ミルの球（ボール）を示す金－スズ合金（フラックス基材に）を含有する。

【０１９５】先端構造８２０は、ここで、復元性のある接触構造、好適には、本発明の複合相互接続要素の端部（先端）への実装（例えば、ろう接）の準備が整う。しかし、複合相互接続要素がまず、先端構造８２０を受けるべく特別に「準備」されるのが好ましい。

【０１９６】図29は、先端構造（８２０）が、複合相互接続要素８３２の端部に実装されるのを予想して、複数（図示では多くのうち２つ）の複合相互接続要素８３２を備えた間隔変換器８３０（５０６に匹敵）を準備するための技法８５０を示す。複合相互接続要素（プローブ要素）８３２は完全に示されている（断面ではなく）。

【０１９７】この例において、複合相互接続要素８３２は、多層（図６に匹敵）であり、金（ワイヤ）コアを有し、これには、銅の層（不図示）で保護膜生成され、更にニッケル（好適には、９０：１０のＮｉ：Ｃｏ比率を有するニッケル－コバルト合金）の層で保護膜生成され、更に、銅の層（不図示）で保護膜生成される。明らかなように、ニッケル層が、その所望の最終厚さの大幅な部分（例えば、８０％）にのみ堆積され、ニッケル厚

の残りの少ない部分（例えば、２０％）は、以下で説明する、後続のステップで堆積されるのが好ましい。

【０１９８】この例では、間隔変換器基板８３０には、その上部（図で見て）表面から延伸する複数（図示では多くのうち２つ）の柱状構造８３４が設けられ、これらは、明らかなように、研磨「ストップ」として機能することになる。これらの研磨ストップを、必ずしも多数備えることは必要でなく、それらは、基板（例えば、セラミック）と同じ材料から容易に形成される。

【０１９９】間隔変換器基板８３０は、次いで、間隔変換器基板の上部表面から延伸する複合接続要素８３２支持するように機能する、熱可溶性、溶剤可溶性ポリマー等の、適切な鋳造材料で「鋳造」される。上成型された基板の上部（図で見て）表面は、次いで、研磨を受けるが、これは例えば、鋳造材料の上部表面へと下方に（図で見て）押圧される、研磨ホイール８３８等によりなされる。上述の研磨ストップ８３４は、表記「Ｐ」の鎖線で示される、研磨ホイールの最終位置を決定する。このようにして、複合相互接続要素８３２の先端（図で見て、上端）が研磨されて、互いに実質的に完全に共平面となる。

【０２００】上記で説明したように、復元性のある接触構造の先端が、試験しようとする半導体ウェーハと共平面をなすこと、及び先端が、ウェーハと実質的に同時の接触をなすように平坦化されることを保証するために、間隔変換器を配向する機構（例えば、差動ネジ、又は自動化機構）が、プローブカード・アセンブリ（５００）全体に設けられる。確かなことに、研磨により（又は、他の任意の手段により）平坦化されている先端での開始は、この重要な目的を達成するのに寄与することになる。更に、何とは言っても、プローブ要素（８３２）の先端の共平面性を保証することによって、間隔変換器構成要素から延伸するプローブ要素（８３２）の先端での非共平面性を吸収する（コンプライアンスにより）ために、介在体構成要素（５３４）に課せられる制約が和らげられる（低減される）。

【０２０１】研磨によるプローブ要素の先端の平坦化が終了した後、鋳造材料８３６が、適切な溶剤で除去される。（研磨ストップ８３４は、この時点で除去されることになる。）鋳造材料は、それらの溶剤と同じく周知のところである。簡単に溶融除去できる、ワックス等の鋳造材料も、研磨に対してプローブ要素（８３２）を支持するために使用可能なことは、本発明の範囲内である。間隔変換器は、このようにして、上述の先端構造（８２０）を受けるべく準備完了となる。

【０２０２】研磨作業の恩恵のある副次的な効果は、複合相互接続要素８３２の金ワイヤステム（コア）に保護膜生成する材料が、先端において除去され、金コアが露出状態にされるという点にある。複合相互接続要素の先端に先端構造（８２０）をろう接することが所望である限りは、ろう接すべき金材料が露出しているのが望ましい。

【０２０３】既に言及したが、好ましいのは、１つ追加のメッキステップを実施して、すなわち、複合相互接続要素８３２をニッケルメッキして、複合相互接続要素を、それらの所望のニッケル全体厚のうちの残りの少ない部分（例えば、２０％）に設けることにより、先端構造を受けるための間隔変換器を更に「準備」することである。

【０２０４】図28に示す準備された基板が、ここで、準備された間隔変換器上に支持される。図30に示すように、先端構造８２０（図示の明瞭化のために、２つの先端構造だけが示されている）は、標準的なフリップ・チップ技法（例えば、分割プリズム）を用いて、複合相互接続要素８３２の先端と位置合わせされ、アセンブリは、連結材料８２４をリフローするためにろう接炉を通過し、それによって、予め製造された先端構造８２０が、接触構造８３２の端部に連結（例えば、ろう接）される。

【０２０５】この技法を用いて、予め製造した先端構造を、復元性のない接触構造、複合相互接続要素、その他に連結（例えば、ろう接）可能であることは、本発明の範囲内である。

【０２０６】リフロー工程時に、非湿潤性である露出したアルミニウム層（８０６）によって、半田（すなわち、ろう）が、先端構造８２０の間で流れるのが防止される、すなわち、半田ブリッジが、隣接する先端構造間に形成されるのが防止される。アルミニウム層のこの湿潤防止機能に加えて、アルミニウム層は又、解放層としても機能する。適切なエッチング剤を用いて、アルミニウムは、選好的に（アセンブリの他の材料に対して）エッチング除去されて、シリコン基板８０２は単純に「勢い良く」下がり、結果として、図31に示すように、各々が予備製造された先端構造を有する複合相互接続要素（プローブ要素）を備えた間隔変換器となる。（ここで留意されたいのは、連結材料８２４は、プローブ要素８３２の端部において「スミ肉」としてリフロー済みである、ということである。）工程の最終ステップにおいて、残留銅（８０８）がエッチング除去されて、先端構造８２０のニッケル（又は、上記のロジウム）が、プローブを当てようとする電子コンポーネントの端子に接触させるために、露出状態で残される。

【０２０７】複合相互接続要素（８３２等）を、図27に関連して説明した先端構造冶金法を利用して、図９－11に関連して説明した技法の「精神」で、自体の先端構造上に先ず製造して、続いて、間隔変換器基板に実装可能であることは、本発明の範囲内であるが、一般には好ましくない。

【０２０８】ろう接（半田付け）ペーストを省いて、その代わりに、共晶材料（例えば、金－スズ）を復元性の

ある接触構造上にメッキした後に、それに接触先端（８２０）を実装することは、本発明の範囲内である。

【０２０９】図面及び以上の説明において、本発明を詳細に例示及び説明してきたが、本発明は、文言における限定としてではなく、例示として見なされるべきである。すなわち、ここで理解されたいのは、好適な実施例のみを図示及び説明したということ、及び本発明の趣旨内に入る全ての変形及び修正も、望ましく保護されるということである。疑うべくもなく、上記の「主題」に関する多数の他の「変形例」も、本発明の最も近くに属する、当該技術で通常の知識を有する者が想到するであろうし、また本明細書に開示されるような変形例は、本発明の範囲内にあることを意図するものである。これら変形例の幾つかは、親事例に記載されている。

【０２１０】例えば、本明細書において記載又は示唆される実施例のいずれかにおいて、マスキング材料（例えば、ホトレジスト）が、基板に施されて、マスクを通過する光への露出、及びマスキング材料の部分の化学的除去（すなわち、慣用的なホトリソグラフ技法）等によってパターニングされる場合、代替技法を使用することもでき、それには、除去しようとするマスキング材料（例えば、ブランケット硬化ホトレジスト）の部分に、適切に平行化された光ビーム（例えば、エキシマ・レーザからの）を向け、それによって、マスキング材料のこれら部分を融除すること、又は適切に平行化された光ビームで、マスキング材料の部分を直接（マスクを使用せずに）硬化し、次いで、未硬化のマスキング材料を化学的に洗浄することが含まれる。

【０２１１】本発明の複合相互接続要素は幾つかあるが、プローブカード・アセンブリの間隔変換器構成要素の端子に直接実装可能である、適切な復元性のある接触構造の１つの例であることは、本発明の範囲内である。例えば、タングステンといった本質的に復元性のある（比較的高い降伏強度）材料からなる針に、半田又は金で被覆を施して、それらの半田付け性を良くし、任意として所望のパターンで支持し、また間隔変換器の端子に半田付けすることが可能なことも、本発明の範囲内である。

【０２１２】

【発明の効果】プローブカード・アセンブリ（５００）が、プローブカード（５０２）と、間隔変換器（５０６）であって、その表面に直接実装され、その表面から延伸する復元性のある接触構造（プローブ要素）（５２４）を有する間隔変換器（５０６）と、間隔変換器（５０６）とプローブカード（５０２）の間に配設される介在体（５０４）とを含む。間隔変換器（５０６）の配向、従ってプローブ要素（５２４）の先端の配向が、プローブカードの配向を変更することなく調整可能なように、間隔変換器（５０６）と介在体が「積み重ね」られる。間隔変換器（５０６）の配向を調整して、どのぐらいの調整をすべきかを決定するための適切な機構（５３２、５３６、５３８、５４６）が開示される。半導体ウェーハ（５０８）上の多数の大・サイトに、開示の技法を用いて容易にプローブが当てられ、プローブ要素（５２４）は、ウェーハ（５０８）全体のプローブ当てを最適化するように配列可能である。復元性のある接触構造としての比較的硬質のシェル（２１８、２２０）により保護膜生成された比較的軟質のコア（２０６）を有する、複合相互接続要素（２００）が記載される。

【０２１３】上記の如き構成により、半導体素子を、特にそれらが半導体ウェーハ上にある間に、プローブ検査するための技法が提供される。またプローブ要素の先端の配向を、プローブカードの位置を変更することなく可能にする、半導体素子にプローブを当てるための技法が提供される。電子コンポーネントの端子に直接実装することが可能である、改良されたばね要素（復元性のある接触構造）が提供される。さらに電子コンポーネントに対して圧力接触をなすのに適した相互接続要素が提供される。

【図面の簡単な説明】

【図１】本発明の１つの実施例に従った、相互接続要素の一端を含めた長手部分の断面図である。

【図２】本発明の他の実施例に従った、相互接続要素の一端を含めた長手部分の断面図である。

【図３】本発明の他の実施例に従った、相互接続要素の一端を含めた長手部分の断面図である。

【図４】本発明の他の実施例に従った、相互接続要素の一端を含めた長手部分の断面図である。

【図５】本発明の他の実施例に従った、相互接続要素の一端を含めた長手部分の断面図である。

【図６】本発明に従って、電子コンポーネントの端子に実装されて、多層化シェルを有する相互接続要素の断面図である。

【図７】本発明に従って、中間層が誘電体材料製である、多層化シェルを有する相互接続要素の断面図である。

【図８】本発明に従って、電子コンポーネント（例えば、プローブカード挿入）に実装される、複数の相互接続要素の斜視図である。

【図９】本発明に従って、相互接続要素を製造するための技法の例示的な第１ステップの断面図である。

【図１０】本発明に従って、相互接続要素を製造するための図９の技法の例示的な更なるステップの断面図である。

【図１１】本発明に従って、相互接続要素を製造するための図10の技法の例示的な更なるステップの断面図である。

【図１２】本発明に従った、図９－11の技法に従って製造された複数の個々の相互接続要素の断面図である。

【図１３】本発明に従った、図９－11の技法に従って製

造されて、互いに規定の空間関係で関連した、例示的な複数の相互接続要素の断面図である。

【図１４】本発明に従って、相互接続要素を製造するための代替実施例の断面図であり、１つの相互接続要素の１つの端部を示す。

【図１５】本発明に従った、介在体の１つの実施例の断面図である。

【図１６】本発明に従った、介在体の他の実施例の断面図である。

【図１７】本発明に従った、介在体の他の実施例の断面図である。

【図１８】本発明に従った、総括的な間隔変換器の１つの実施例の断面図である。

【図１９】本発明のプローブカード・アセンブリの、部分的に断面を示す分解組立図である。

【図２０】本発明に従って、図19のプローブカード・アセンブリにおいて用いるのに適した、１つの間隔変換器構成要素の斜視図である。

【図２１】本発明に従って、図19のプローブカード・アセンブリにおいて用いるのに適した、他の間隔変換器構成要素の斜視図である。

【図２２】本発明に従って、図19のプローブカード・アセンブリにおいて用いるのに適した、１つの間隔変換器の下面図である。

【図２３】本発明に従って、図19のプローブカード・アセンブリにおいて用いるための、代表的な介在体基板の上部表面、又は下部表面のうちどちらかの下面図である。

【図２４】本発明に従った、図23に示す介在体構成要素＊の部分断面図である。

【図２５】本発明に従って、半導体ウェーハを試験する際に用いるのに整合し、図19に示すプローブカード・アセンブリに類似した、１つのプローブカード・アセンブリの部分断面、及び部分概略図である。

【図２６】本発明に従って、間隔変換器構成要素の配向を自動的に調整するための技法の部分断面、及び部分概略図である。

【図２７】本発明に従って、プローブ要素に対して先端構造を製造するための技法の断面図である。

【図２８】本発明に従った、図27の技法における更なるステップの断面図である。

【図２９】本発明に従った、間隔変換器構成要素の部分的に断面を、及び部分的に全体を示す側面図である。

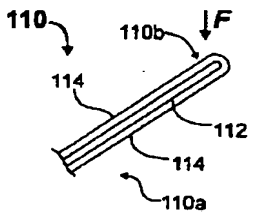
【図３０】本発明に従った、図28の先端構造と連結される図29の間隔変換器構成要素の部分的に断面を、及び部分的に全体を示す側面図である。

【図３１】本発明に従って、図28の先端構造と連結される図29の間隔変換器構成要素を連結する際の更なるステップの部分的に断面を、及び部分的に全体を示す側面図である。

【符号の説明】

500	プローブカード・アセンブリ
502	プローブカード
504	介在体
506	間隔変換器
508	半導体ウェーハ
524	プローブ要素

【図１】



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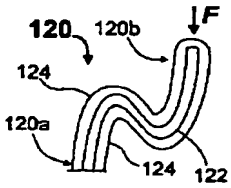

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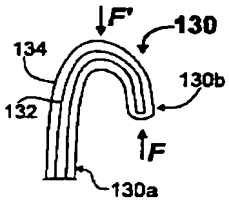

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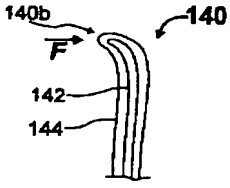

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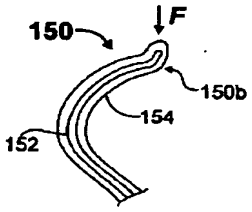
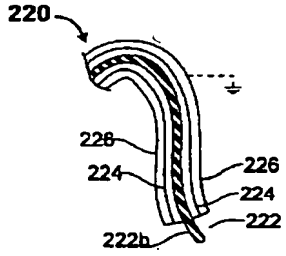


【図７】



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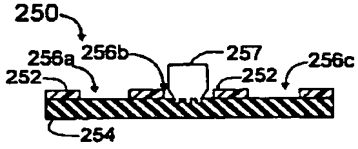

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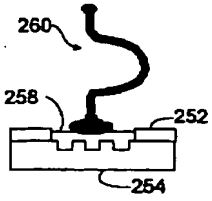
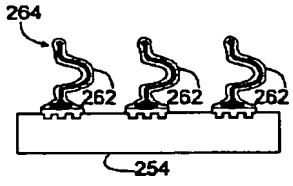


【図１１】



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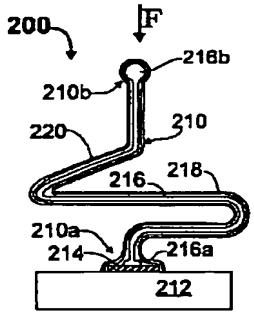

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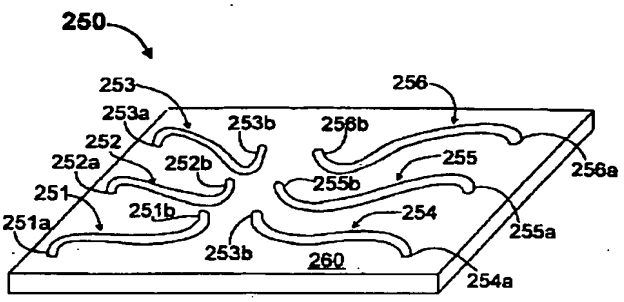
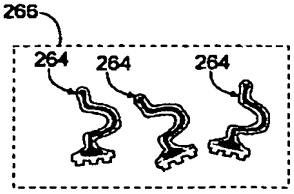


【図１２】



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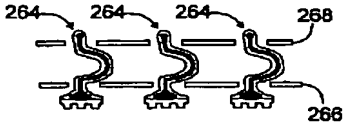
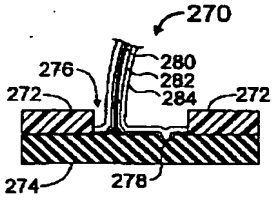
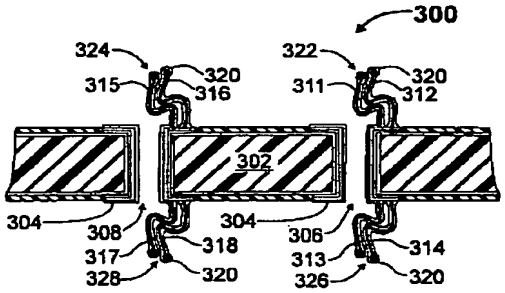


【図１４】



【図１５】



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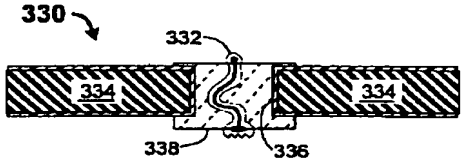

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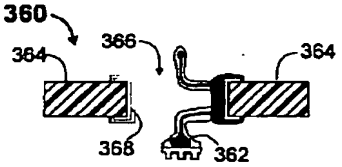

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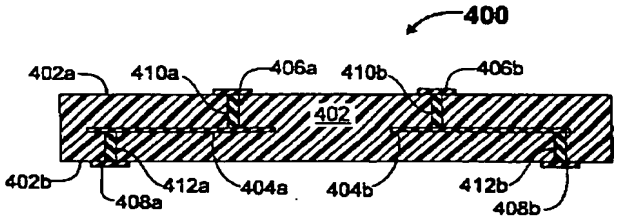

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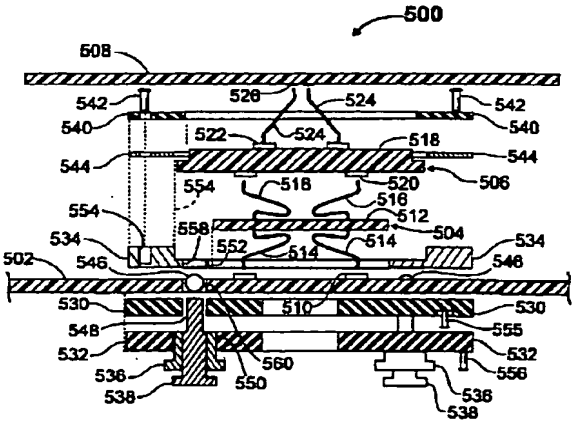

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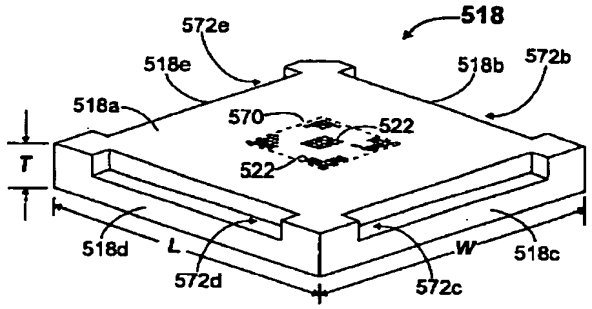

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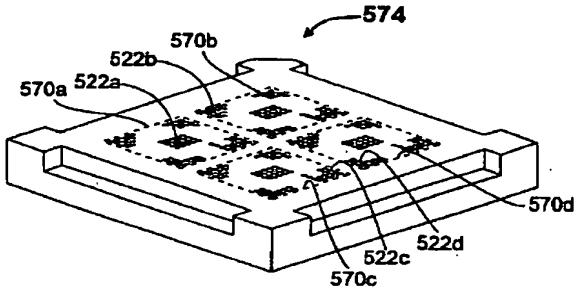

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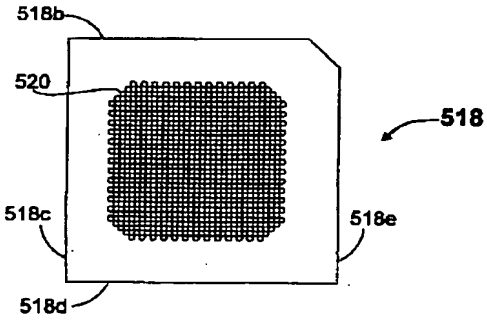

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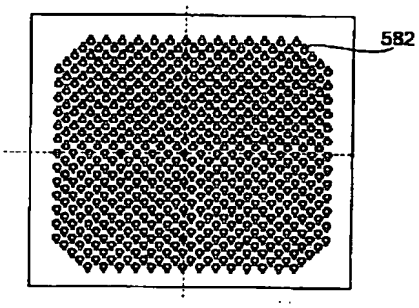

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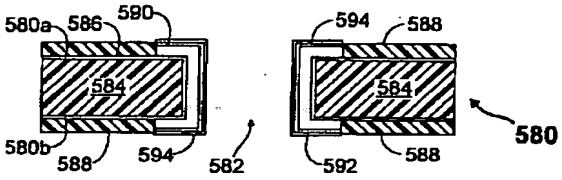

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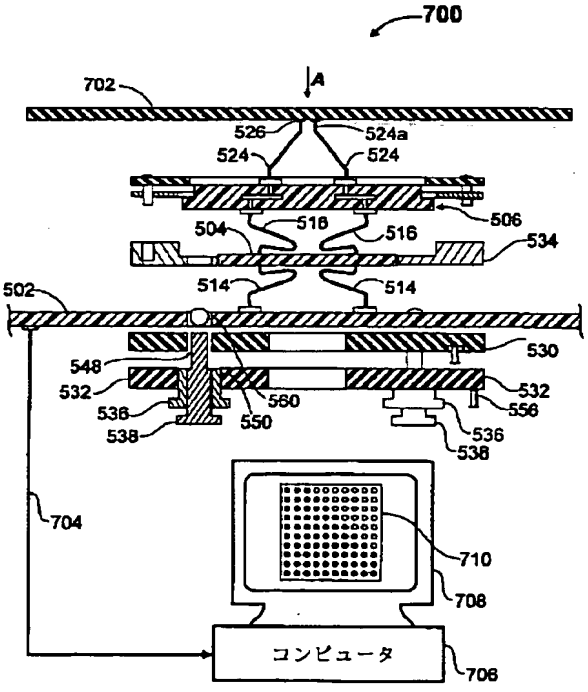

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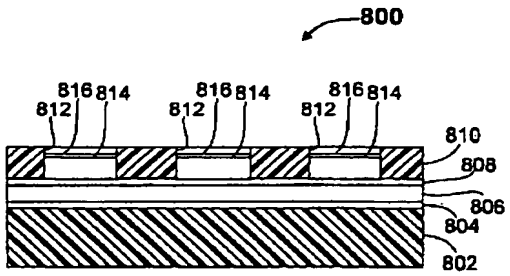

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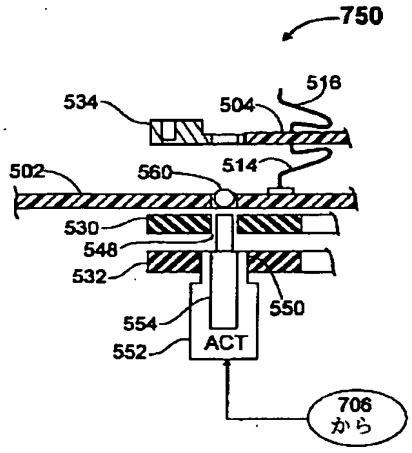

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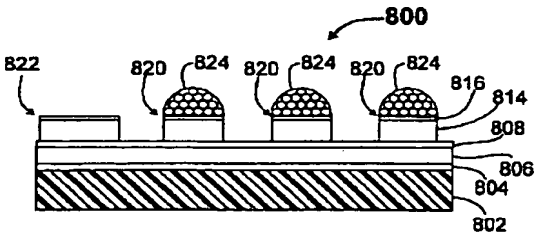

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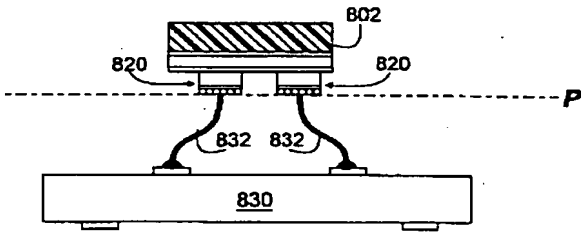

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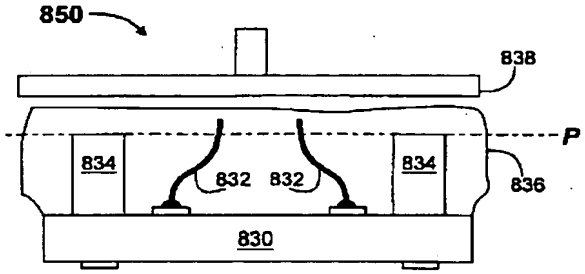

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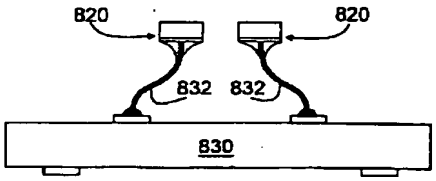

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【手続補正書】
【提出日】平成１４年１０月２日（２００２．１０．２）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　プローブカード・アセンブリ用の間隔変換器において、
上部表面、下部表面、該上部表面に配設される第１の複数の端子、及び上記下部表面に配設される第２の複数の端子を有する、間隔変換器基板と、
上記第１の複数の端子に直接実装される、第１の複数の復元性のある接触構造と、からなる間隔変換器。
【請求項２】　前記第１の複数の復元性のある接触構造の端部に実装される、先端構造から更になる、請求項１に記載の間隔変換器。
【請求項３】　前記第１の複数の復元性のある接触構造は、複合相互接続要素である、請求項１に記載の間隔変換器。
【請求項４】　前記第１の複数の復元性のある接触構造は、前記第１の複数の端子に直接、前記第１の複数の復元性のある接触構造を実装する前に、犠牲基板上に製造される、請求項１に記載の間隔変換器。
【請求項５】　前記第２の複数の端子に直接実装される、第２の複数の復元性のある接触構造から更になる、請求項１に記載の間隔変換器。
【請求項６】　前記第２の複数の復元性のある接触構造は、複合相互接続要素である、請求項１に記載の間隔変換器。
【請求項７】　前記第２の複数の復元性のある接触構造は、前記第２の複数の端子に直接、前記第２の複数の復元性のある接触構造を実装する前に、犠牲基板上に製造される、請求項１に記載の間隔変換器。
【請求項８】　プローブカード・アセンブリにおいて、
プローブカードであって、上部表面、下部表面、及び該上部表面における複数の接触端子を有するプローブカードと、
介在体であって、上部表面、下部表面、介在体の下部表面から延伸する第１の複数の復元性のある接触構造、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有する介在体と、
間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、及び間隔変換器の上部表面から延伸する第３の複数の復元性のある接触構造を有する間隔変換器と、
上記第１の複数の復元性のある接触構造は、上記プローブカードの接触端子との圧力接続をもたらすことと、
上記第２の複数の復元性のある接触構造は、上記間隔変

換器の接触パッドとの圧力接続をもたらすことと、
からなるプローブカード・アセンブリ。
【請求項９】　前記第３の複数の復元性のある接触構造は、前記間隔変換器の上部表面における端子に直接実装される、請求項８に記載のプローブカード・アセンブリ。
【請求項１０】　前記第１の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。
【請求項１１】　前記第２の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。
【請求項１２】　前記第３の複数の復元性のある接触構造は、複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。
【請求項１３】　前記第１の複数の復元性のある接触構造の各々は、少なくとも２つの複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。
【請求項１４】　前記第２の複数の復元性のある接触構造の各々は、少なくとも２つの複合相互接続要素である、請求項８に記載のプローブカード・アセンブリ。
【請求項１５】　堅固な材料から製作され、上部表面及び下部表面を有して、該下部表面が前記プローブカードの前記上部表面に対抗して配設される前部実装プレートと、
前記プローブカードの前記上部表面に、上記前部実装プレートを固定するための手段と、
前記プローブカードの前記上部表面に対抗して、前記間隔変換器を押圧するための手段と、
から更になる、請求項８に記載のプローブカード・アセンブリ。
【請求項１６】　前記前部実装プレートは、ステンレス鋼から製作される、請求項１５に記載のプローブカード・アセンブリ。
【請求項１７】　前記間隔変換器を押圧するための前記手段は、
実装リングと、
該実装リングを前記前部実装プレートに対して、それらの間に捕捉される前記
間隔変換器と共に保持する複数のネジと、からなる、請求項１５に記載のプローブカード・アセンブリ。
【請求項１８】　前記実装リングは、弾力のある材料から製作される、請求項１７に記載のプローブカード・アセンブリ。
【請求項１９】　前記実装リングと前記間隔変換器の間に配設される、スペーサリングから更になる、請求項１７に記載のプローブカード・アセンブリ。
【請求項２０】　前記前部実装プレートを固定するための前記手段は、上部表面及び下部表面を有し、該上部表面が前記プローブカードの前記下部表面に対抗して配設される、背部実装プレートと、
前記プローブカードを介して、前記前部実装プレートと上記背部実装プレートの間で延伸する複数のネジと、からなる、請求項１５に記載のプローブカード・アセンブリ。
【請求項２１】　前記背部実装プレートは、ステンレス鋼から製作される、請求項２０に記載のプローブカード・アセンブリ。
【請求項２２】　前記プローブカードの配向を変更することなく、前記間隔変換器の平面性を調整するための手段から更になる、請求項８に記載のプローブカード・アセンブリ。
【請求項２３】　前記間隔変換器の平面性を調整するための前記手段は、複数の差動ネジからなり、その各々は、前記間隔変換器の下部表面に作用する、外部の差動ネジ要素と内部の差動ネジ要素を含む、請求項２２に記載のプローブカード・アセンブリ。
【請求項２４】　前記内部の差動ネジ要素の端部に配設される、複数の枢軸球から更になる、請求項２３に記載のプローブカード・アセンブリ。
【請求項２５】　前記プローブカードの直ぐ下に配設されるアクチュエータ実装プレートから更になり、前記差動ネジは、該アクチュエータ実装プレート内へとネジ通しされる、請求項２３に記載のプローブカード・アセンブリ。
【請求項２６】　前記間隔変換器の平面性を調整するための前記手段は、コンピュータに応答して、前記間隔変換器の下部表面に作用する、複数のアクチュエータからなる、請求項２２に記載のプローブカード・アセンブリ。
【請求項２７】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第３の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項８に記載のプローブカード・アセンブリ。
【請求項２８】　前記第１の複数の復元性のある接触構造は、第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第２のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチと同一である、請求項８に記載のプローブカード・アセンブリ。
【請求項２９】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第３の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、前記第１の複数の復元性のある接触構造は、上記第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、上記第１のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチよ

りも大きい、請求項８に記載のプローブカード・アセンブリ。

【請求項３０】　プローブカード・キットにおいて、

間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、間隔変換器の上部表面から延伸する第１の複数の復元性のある接触構造を有して、半導体ウェーハ上の複数の接触領域と圧力接触をなす、上記第１の複数の復元性のある接触構造の先端に対して用いるのに適応した、間隔変換器と、

介在体であって、上部表面、下部表面、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有して、上記間隔変換器の下部表面における上記複数の接触パッドと圧力接続をなす、上記第２の複数の復元性のある接触構造の先端に対して用いるのに適応し、介在体の下部表面から延伸する第３の複数の復元性のある接触構造を有して、プローブカード上の複数の端子と圧力接続をなす、第３の複数の接触構造の先端に対して用いるのに適応した、介在体と、からなるプローブカード・キット。

【請求項３１】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第１の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項３０に記載のプローブカード・キット。

【請求項３２】　前記第３の複数の接触構造は、復元性があり、かつ第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第２のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチと同一である、請求項３０に記載のプローブカード・キット。

【請求項３３】　前記接触パッドは、第１のピッチで、前記間隔変換器の下部表面に配設され、前記第１の複数の復元性のある接触構造は、第２のピッチで、前記間隔変換器の上部表面に配設され、前記第３の複数の接触構造は、復元性があり、かつ第１のピッチで、前記介在体の下部表面に配設され、前記第２の複数の復元性のある接触構造は、第１のピッチで、前記介在体の上部表面に配設され、上記第１のピッチは、上記第２のピッチよりも大きい、請求項３０に記載のプローブカード・キット。

【請求項３４】　復元性のある接触構造において、

端部を有する複合相互接続要素と、

該複合相互接続要素の上記端部に連結される、予備製造の先端構造と、

からなる復元性のある接触構造。

【請求項３５】　前記復元性のある接触構造は、間隔変換器に実装されるプローブ要素である、請求項３４に記載の復元性のある接触構造。

【請求項３６】　接触構造の端部に対して先端構造を製造する方法において、

シリコンウェーハ上に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、

上記少なくとも１つの導電層の頂部に、マスキング材料の層を堆積するステップと、

上記マスキング材料において開口をパターニングするステップと、

上記開口内に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、

上記マスキング材料を除去するステップと、を含む方法。

【請求項３７】　前記開口内に以前に堆積した少なくとも１つの導電材料の前記少なくとも１つの層上に、連結材料を堆積するステップを更に含む、請求項３６に記載の方法。

【請求項３８】　前記接触構造の端部に前記先端構造を連結するステップを更に含む、請求項３７に記載の方法。

【請求項３９】　前記接触構造は、復元性のある接触構造である、請求項３８に記載の方法。

【請求項４０】　前記接触構造は、複合相互接続要素である、請求項３８に記載の方法。

【請求項４１】　前記接触構造は、プローブカード・アセンブリの間隔変換器の頂部に配設される、復元性のある接触構造である、請求項３８に記載の方法。

【請求項４２】　複数の電気接点を含むプローブカードと、

複数の細長く弾性的なプローブ要素を有するプローブ基板と、

前記プローブカードと前記プローブ基板の間に配置され、前記プローブ要素の１つと前記電気接点の１つを電気的に接続する従順な相互接続構造とからなるプローブカード・アセンブリ。

【請求項４３】　前記従順な相互接続構造が、前記相互接続構造の両面から延伸する複数の細長い相互接続要素を含む、請求項４２に記載のプローブカード・アセンブリ。

【請求項４４】　前記複数の細長い相互接続要素のそれぞれが、前記細長い要素が前記従順な相互接続構造の開口通過するように配置され、前記細長い相互接続要素の両端が前記相互接続構造の両面から隔置されている、請求項４３に記載のプローブカード・アセンブリ。

【請求項４５】　前記複数の細長い相互接続要素が前記プローブカード及び前記プローブ構造に対して力を及ぼす、請求項４３に記載のプローブカード・アセンブリ。

【請求項４６】　前記力がバネ力である、請求項４５に記載のプローブカード・アセンブリ。

【請求項４７】　前記細長い相互接続要素が弾性的である、請求項４３に記載のプローブカード・アセンブリ。

【請求項４８】　前記細長い相互接続要素の少なくとも

１つが、第１の材料からなるコア及び第２の材料からなる被覆を含み、該第２の材料が該第１の材料よりも弾性的である、請求項４７に記載のプローブカード・アセンブリ。

【請求項４９】　さらに前記プローブカードに対して前記プローブカードの傾きを調節する手段を含む、請求項４２に記載のプローブカード･アセンブリ。

【請求項５０】　さらに前記プローブカードに対する前記プローブカードの傾きに変化を与えるように配置されている少なくとも１つの移動可能要素を含む、請求項４２に記載のプローブカード･アセンブリ。

【請求項５１】　前記移動可能要素が、ねじ山を付けられている、請求項５０に記載のプローブカード・アセンブリ。

【請求項５２】　前記移動可能要素がねじを含む、請求項５０に記載のプローブカード・アセンブリ。

【請求項５３】　前記ねじが作動ねじを含む、請求項５２に記載のプローブカード・アセンブリ。

【請求項５４】　さらに当該移動可能要素の第１の方向への移動が前記プローブ基板の少なくとも一部分を前記プローブカードの方へ移動させるように配置されている少なくとも１つの移動可能要素を含む、請求項４２に記載のプローブカード･アセンブリ。

【請求項５５】　さらに前記移動可能要素の第２の方向への移動が、前記プローブ基板の少なくとも一部分が前記プローブカードから離れることを可能とする、請求項５４に記載のプローブカード・アセンブリ。

【請求項５６】　前記プローブカードの部分に対する前記プローブ基板の部分の位置に影響を与えるように、それぞれが配置されている複数の移動可能要素を含む、請求項４２に記載のプローブカード・アセンブリ。

【請求項５７】　さらに前記プローブカードに対して前記プローブ基板の位置を調節するように配置されているサーボ機構を含む、請求項４２に記載のプローブカード・アセンブリ。

【請求項５８】　さらに前記プローブカードに対して前記プローブ基板の位置を調節するように配置されている圧電アクチュエータを含む、請求項４２に記載のプローブカード・アセンブリ。

【請求項５９】　前記プローブ基板が間隔変換器を含む、請求項４２に記載のプローブカード･アセンブリ。

【請求項６０】　前記プローブ要素が、第１の材料からなるコア及び第２の材料からなる被覆を含み、該第２の材料が該第１の材料よりも弾性的である、請求項４２に記載のプローブカード・アセンブリ。

【請求項６１】　テスターと電気的に接触させるためのプローブカード手段と、
試験下の半導体素子に細長く弾性的な電気接点を設けるためのプローブ基板手段と、
前記プローブカード手段と前記プローブ基板手段を電気的に従順に接続するための相互接続手段とからなるプローブカード・アセンブリ。

【請求項６２】　前記相互接続手段が、それぞれが前記プローブ基板手段の前記電気接点の１つと前記プローブカード手段の前記電気接点の１つを電気的に弾性的に接続する複数の細長い相互接続要素を含む、請求項６１に記載のプローブカード・アセンブリ。

【請求項６３】　さらに前記プローブカード手段に対して前記プローブ基板手段の傾きを調節するための手段を含む、請求項６１に記載のプローブカード・アセンブリ。

【請求項６４】　複数の電気接点を含むプローブカードと、
前記プローブカードに移動可能に固定されているとともに複数の細長く弾性的なプローブ要素を有するプローブ基板と、該細長く弾性的なプローブ要素のそれぞれが、前記電気接点の１つと導通することと、
前記プローブカードに対する前記プローブ基板の傾きに変化を与えるように配置されている移動可能要素とからなるプローブカード・アセンブリ。

【請求項６５】　前記移動可能要素の第１の方向への移動が、前記プローブ基板の少なくとも一部分を前記プローブカードから離れるように移動させる、請求項６４に記載のプローブカード･アセンブリ。

【請求項６６】　前記移動可能要素の第２の方向への移動が、前記プローブ基板の少なくとも一部分を前記プローブカードの方へ移動させる、請求項６５に記載のプローブカード・アセンブリ。

【請求項６７】　前記移動可能要素が、ねじ山を付けられている、請求項６４に記載のプローブカード・アセンブリ。

【請求項６８】　前記移動可能要素がねじを含む、請求項６４に記載のプローブカード・アセンブリ。

【請求項６９】　前記ねじが作動ねじを含む、請求項６８に記載のプローブカード・アセンブリ。

【請求項７０】　前記移動可能要素がサーボ機構を含む、請求項６４に記載のプローブカード・アセンブリ。

【請求項７１】　前記移動可能要素が圧電アクチュエータを含む、請求項６４に記載のプローブカード・アセンブリ。

【請求項７２】　前記プローブカードの部分に対する前記プローブ基板の部分の位置に影響を与えるように、それぞれが配置されている複数の移動可能要素を含む、請求項６４に記載のプローブカード・アセンブリ。

【請求項７３】　前記プローブ基板が間隔変換器である、請求項６４に記載のプローブカード・アセンブリ。

【請求項７４】　前記プローブ要素が、第１の材料からなるコア及び第２の材料からなる被覆を含み、該第２の材料が該第１の材料よりも弾性的である、請求項６４に記載のプローブカード・アセンブリ。

【請求項７５】　半導体テスターにインタフェイスを設けるためのプローブカード手段と、
複数の細長く弾性的なプローブ要素を支持するためのプローブ基板手段と、前記プローブ要素が前記プローブカード導通し、前記プローブ基板手段が前記プローブカード手段に移動可能に固定されていることと、
前記プローブカード手段に対して前記プローブ基板手段の傾きを調節するための手段とからなるプローブカード・アセンブリ。

【請求項７６】　前記プローブ要素が、第１の材料からなるコア及び第２の材料からなる被覆を含み、該第２の材料が該第１の材料よりも弾性的である、請求項７５に記載のプローブカード・アセンブリ。

【請求項７７】　さらに前記プローブカード手段と前記プローブ基板手段の間に配置され、前記プローブカード手段と前記プローブ基板手段に対して力を及ぼす介在体手段からなる、請求項７５に記載のプローブカード・アセンブリ。

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第７部門第１区分
【発行日】平成１５年２月２８日（２００３．２．２８）

【公開番号】特開２０００－６７９５３（Ｐ２０００－６７９５３Ａ）
【公開日】平成１２年３月３日（２０００．３．３）
【年通号数】公開特許公報１２－６８０
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【手続補正書】
【提出日】平成１４年１１月１３日（２００２．１１．１３）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　プローブカード・アセンブリ用の間隔変換器において、
上部表面、下部表面、該上部表面に配設される第１の複数の端子、及び上記下部表面に配設される第２の複数の端子を有する、間隔変換器基板と、
上記第１の複数の端子に直接実装される、第１の複数の復元性のある接触構造と、
からなる間隔変換器。
【請求項２】　プローブカード・アセンブリにおいて、
プローブカードであって、上部表面、下部表面、及び該上部表面における複数の接触端子を有するプローブカードと、
介在体であって、上部表面、下部表面、介在体の下部表面から延伸する第１の複数の復元性のある接触構造、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有する介在体と、
間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、及び間隔変換器の上部表面から延伸する第３の複数の復元性のある接触構造を有する間隔変換器と、を備え、
上記第１の複数の復元性のある接触構造は、上記プローブカードの接触端子との圧力接続をもたらし、
上記第２の複数の復元性のある接触構造は、上記間隔変換器の接触パッドとの圧力接続をもたらす、
プローブカード・アセンブリ。
【請求項３】　プローブカード・キットにおいて、
間隔変換器であって、上部表面、下部表面、間隔変換器の下部表面に配設される複数の接触パッド、間隔変換器の上部表面から延伸する第１の複数の復元性のある接触構造を有して、半導体ウェーハ上の複数の接触領域と圧力接触をなす、上記第１の複数の復元性のある接触構造の先端に対して用いるのに適応した、間隔変換器と、
介在体であって、上部表面、下部表面、及び介在体の上部表面から延伸する第２の複数の復元性のある接触構造を有して、上記間隔変換器の下部表面における上記複数の接触パッドと圧力接続をなす、上記第２の複数の復元性のある接触構造の先端に対して用いるのに適応し、介在体の下部表面から延伸する第３の複数の復元性のある接触構造を有して、プローブカード上の複数の端子と圧力接続をなす、第３の複数の復元性のある接触構造の先端に対して用いるのに適応した、介在体と、
からなるプローブカード・キット。

【請求項４】　復元性のある接触構造において、
端部を有する複合相互接続要素と、
該複合相互接続要素の上記端部に連結される、予備製造の先端構造と、からなる復元性のある接触構造。
【請求項５】　接触構造の端部に対して先端構造を製造する方法において、シリコンウェーハ上に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、
上記少なくとも１つの導電層の頂部に、マスキング材料の層を堆積するステップと、
上記マスキング材料において開口をパターニングするステップと、
上記開口内に、少なくとも１つの導電材料の少なくとも１つの層を堆積するステップと、
上記マスキング材料を除去するステップと、
を含む方法。
【請求項６】　複数の電気接点を含むプローブカードと、
複数の細長く弾性的なプローブ要素を有するプローブ基板と、
前記プローブカードと前記プローブ基板との間に配置され、前記プローブ要素の１つと前記電気接点の１つを電気的に接続する従順な相互接続構造と、からなるプローブカード・アセンブリ。
【請求項７】　テスターと電気的に接触させるためのプローブカード手段と、
試験下の半導体素子に細長く弾性的な電気接点を設けるためのプローブ基板手段と、
前記プローブカード手段と前記プローブ基板手段とを電気的に従順に接続するための相互接続手段と、
からなるプローブカード・アセンブリ。
【請求項８】　複数の電気接点を含むプローブカードと、
前記プローブカードに移動可能に固定されているとともに複数の細長く弾性的なプローブ要素を有し、該細長く弾性的なプローブ要素のそれぞれが、前記電気接点の１つと導通する、プローブ基板と、
前記プローブカードに対する前記プローブ基板の傾きに変化を与えるように配置されている移動可能要素と、
からなるプローブカード・アセンブリ。
【請求項９】　半導体テスターにインタフェイスを設けるためのプローブカード手段と、
複数の細長く弾性的なプローブ要素を支持し、前記プローブ要素が前記プローブカード手段に導通し、前記プローブカード手段に移動可能に固定されている、プローブ基板手段と、
前記プローブカード手段に対して前記プローブ基板手段の傾きを調整するための手段と、
からなるプローブカード・アセンブリ。